A star (✱) indicates that the Abstract deals with Apparatus and Instruments.

FEBRUARY, 1938.

GENERAL PHYSICS.

ADSORPTION. (See Surface Properties.)

ATOMIC AND MOLECULAR STRUCTURE.

388. Recent Results of Experimental Nuclear Investigations. R. Fleischmann. *Zeits. f. techn. Physik*, 18. 12. *pp.* 498–503, 1937. *Phys. Zeits.* 38. *pp.* 924–929, *Dec.* 1, 1937.—A survey is given of progress made in the last two years in the following three phases of nuclear research :—experimental technique, artificial nuclear transformation and the behaviour of slow neutrons. With regard to progress in experimental technique mention is made of the use of protons, deuterons and neutrons as bombarding particles and of the applications of the cyclotron and of high voltage d.c. generators resulting in the attainment of exceptionally high intensities. The most noteworthy advances in relation to new types of nuclear transformation are the discoveries of resonance phenomena in (p, γ) and (α, n) transformations, and the investigations of $(n, 2n)$ and (γ, n) processes leading to the production of new radioactive isotopes. The great advance in knowledge of the properties of slow neutrons and of phenomena associated with their passage through matter is indicated as are also the methods whereby their energies have recently been measured. It is shown how many nuclear phenomena find a unitary explanation on the basis of a model recently propounded by Bohr. In a final paragraph mention is made of the discovery of isomeric nuclei, the transformation series of trans-uranium atoms and the determination of the magnetic moment of the neutron. J. E. K.

389. Theoretical Investigation of Nuclear Forces. F. Hund. *Zeits. f. techn. Physik*, 18. 12. *pp.* 503–509, 1937. *Phys. Zeits.* 38. *pp.* 929–935, *Dec.* 1, 1937.—This paper comprises a survey of the advances made in the last 2 years in the theoretical investigation of the forces prevailing inside atomic nuclei. The scope of the survey can be judged from the following list of main and sub-headings under which the subject matter is grouped ; I. General Inferences : Numbers of protons and neutrons in nuclei ; nuclei in the ground state ; excited nuclei ; β-transformation ; scattering of nuclear particles. II. Forces between Nuclear Particles : the proton-neutron force ; the proton-proton force ; the saturation conditions. III. The Structure of Nuclei : general properties ; nuclear models ; shell structure ; rotational moment ; magnetic moments ; term structures. J. E. K.

390. Energy Levels of a Heavy Nucleus. I. Gurevitsch. *Phys. Zeits. d. Sowjetunion*, 12. 4. *pp.* 489–490, 1937. *In English.*—In a recent paper, Landau [see Abstract 2874 (1937)] has given an approximate formula for the number of levels of a liquid model of an atomic nucleus with the excitation energy between 0 and ϵ, *viz.* $n(\epsilon) = e^{\sqrt{2a\epsilon}}$, where a is a constant in the expression of the free energy $F = -\frac{1}{2} a \Theta^2$, $\Theta = kT$. The formula of Landau is only logarithmically true, and the author now puts forward a better solution, the ratio of his approximate expression (and not merely of its logarithm) to the exact value tending to 1 with $\epsilon \rightarrow \infty$ [it becomes practically 1 as soon as $n(\epsilon) \gg 1$], *viz.*, $n(\epsilon) = e^{\sqrt{2a\epsilon}}/2^{\frac{1}{2}}\pi^{\frac{1}{2}}a^{\frac{1}{4}}\epsilon^{\frac{3}{4}}$. These formulæ lead to the following result for the distance between two neighbouring resonance levels: $D = 2\pi K^{3/2}\Theta^{5/2}\sigma^{1/2}e^{-\sigma}/h^3$, where K is the moment of inertia of the nucleus (supposed to be spherical), σ is the entropy, and h is Planck's constant divided by 2π. Landau's result was $D = \sqrt{2\pi}\,K^{3/2}\Theta^{5/2}e^{-\sigma}/h^3$. H. H. Ho.

391. Exchange Phenomena and Isomeric Nuclei. T. Kahan. *Comptes Rendus*, 205. *pp*. 899–900, *Nov*. 15, 1937.—From general considerations it is deduced that if a diatomic molecule containing two identical nuclei shows alternating intensity in its band spectra, this alternation disappears if one of the nuclei is replaced by an isomer. F. C. C.

392. Molecular Viewpoints in Nuclear Structure. J. A. Wheeler. *Phys. Rev.* 52. *pp*. 1083–1106, *Dec*. 1, 1937.—A study of the transition between the H_3^+ molecule and the corresponding three-body nucleus leads to a conception of the system as of two parts (heavy particle; heavy and light particles), between which acts an effective potential, and an approximate wave function giving the best possible representation of the motion of the three particles. This wave function represents a state in which the system resonates between the groupings atom-ion and ion-atom, and is adapted to the treatment of the scattering of neutrons in deuterium and to the calculation of the binding energy of H^3. Application of the same type of function to the description of nuclear structure in general gives rise to the concept of resonating group structure, which regards the constituent neutrons and protons as divided into various rapidly changing groups. Conditions are found for the possibility of a simple description of the nuclear motion in terms of the relative displacements of the clusters for low excitation energies. When the nuclear energy is higher, the groups provide only a suitable mathematical scheme to treat the nuclear motion. Allowed types of motion and energies for low states of Be^8, C^{12}, and O^{16} are calculated in terms of the relative motion of α-particle groups. The modes of vibration are closely related to those given by the liquid model of Bohr and Kalckar. A discussion of the possible existence of many-body forces is given. [See following Abstract]. N. M. B.

393. Mathematical Description of Light Nuclei by the Method of Resonating Group Structure. J. A. Wheeler. *Phys. Rev.* 52. *pp*. 1107–1122, *Dec*. 1, 1937.—The wave function for the composite nucleus [see preceding Abstract] is written as a properly antisymmetrised combination of partial wave functions, corresponding to various possible ways of distributing the neutrons and protons into different groups. An analysis is carried out in detail for the case of configurations containing only two groups, and integral equations are derived for the functions of separation. The associated Fredholm determinant completely determines the stable energy values of the system, and, with derived equations, determines all scattering and disintegration cross-sections. N. M. B.

394. First Report of the Committee on Atoms of the International Union of Chemistry. F. W. Aston, N. Bohr, O. Hahn, W. D. Harkins, G. Urbain. *Chem. Soc., J. pp*. 1910–1914, *Dec*., 1937.—The Committee issues this first table of isotopes in the hope that it will be of service to those working on nuclear disintegration. It is not proposed to quote the numerous authorities on which this table is based, but it will

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be revised at frequent intervals and supplemented with a table of isotopic weights later.

395. Isotopic Constitution of Snow and Mountain River Water. A. E. Brodsky, O. C. Scarre, E. I. Donzowa and M. M. Sluckaia. *Acta Physicochimica*, 7. 4. *pp*. 611–620, 1937.—A method is described by which the density of water can be determined with an error of 0·3 to 0·4 γ. The contents of D and O^{18} in three samples of snow and eight samples of water from Caucasian mountain rivers are determined by measurements of density and refractive index. The snow is found to contain about 0·2 to 0·3% less D and 1 to 2% more O^{18} than normal river water. In winter the isotopic constitution of the mountain river water is normal, but later in the year is influenced by the melting of the snows. An exchange experiment between ordinary water and atmospheric oxygen is carried out and a density increase amounting to 10·7 γ, due to enrichment of O^{18}, is observed. This result is in agreement with theoretical considerations.
L. A. W.

396. Indication of a Genetic Relation Between Indium and Tin. E. D. Eastman. *Phys. Rev.* 52. *pp*. 1226–1227, *Dec*. 15, 1937.—Existing data reveal a widespread association of In and Sn in ores of the latter element. This is taken as an indication of a genetic relation, ascribed to a " forbidden " transition of Sn^{115} to In^{115}. AUTHOR.

397. Enrichment of Rubidium Isotopes. W. Walcher. *Zeits. f. techn. Physik*, 18. 12. *pp*. 535–538, 1937. *Phys. Zeits.* 38. *pp*. 961–964, *Dec*. 1, 1937.—By means of a mass spectrograph of high intensity the ions of Rb^{87} and Rb^{85} are separately focussed and collected in carbon cylinders in amounts sufficient to permit the investigation of the hyperfine structures of the resonance lines of the two samples excited in a Schüler-Gollnow hollow kathode discharge. The spectrograms, obtained with Fabry-Perot etalons, indicate that samples of Rb^{85} containing about 0·5% Rb^{87} and of Rb^{87} containing about 5% Rb^{85} were obtained by this method.
J. E. K.

398. Separation of Lithium Isotopes. L. Holleck. *Zeits. f. Elektrochem*. 44. *pp*. 111–120, *Jan*., 1938.—18 l. of a 50% LiCl solution is electrolysed with a flowing Hg kathode as in the industrial NaOH-Cl_2 process. By triple step-wise repetition, a factor of about 0·001 is obtained. The atomic weight of Li in the resulting product, determined *via* $AgNO_3$, is found to be 6·89 against 6·94 for the initial LiCl, indicating a 71% Li^6 enrichment. The separation factor for this method is calculated to be 1·079. Difficulties encountered are gradual accumulation of impurities (*e.g*., 23% Na) along with Li^6, in the end-product; and the extreme accuracy required in chemical analysis owing to the small differences involved. D. R. H.

399. Mass Ratio of the Carbon Isotopes from the Spectrum of CN. F. A. Jenkins and D. E. Wooldridge. *Phys. Rev.* 53. *pp*. 137–140, *Jan*. 15, 1938.—With a source containing C enriched about ten times in C^{13}, the violet CN bands have been photographed with a dispersion of 0·63 Å/mm. Measurements are given of the lines of low rotational quantum number in the 0,0, 0,1 and 0,2 bands of $C^{13}N^{14}$, as well as of $C^{12}N^{14}$. The vibrational constants of the normal states of both molecules are accurately determined, and give a value of the isotope mass coefficient $\rho = \omega_e{}^i/\omega_e$ of $0{\cdot}97898 \pm 0{\cdot}00002$, corresponding to a mass of C^{13} of 13·0088. This is in essential agreement with the mass-spectrograph value, and it is shown that the finer corrections to the isotope effect are negligible in this case. AUTHORS.

400. Valencies of Carbon. R. Truchet. *Comptes Rendus*, 205. *pp*. 1074–1076, *Nov*. 29, 1937.—The parts played by the respective valency electrons of the C atom existing either in the tetrahedral or plane form are briefly discussed and the results are applied to explain certain of the spectral, chemical and magnetic characteristics of carbon compounds.— J. S. G. T.

401. Energetical Interpretation of the Semipolar Double Bond. R. Samuel. *Indian Acad. Sci., Proc.* 6*A*. *pp*. 257–265, *Nov*., 1937.—Owing to divergent views on the character of the second N = O bond of the nitro-group, an energetical interpretation is developed, based on a number of experiments on photodissociation and thermochemical and band spectral data of inorganic molecules, against the existence of such coordinate linkages as semipolar bonds in simple inorganic molecules of the first order. N. M. B.

402. Electron Diffraction Investigation of Nitrosyl Chloride and Nitrosyl Bromide. J. A. A. Ketelaar and K. J. Palmer. *Am. Chem. Soc., J.* 59. *pp*. 2629–2633, *Dec*., 1937.—The arrangements of atoms in the molecules of nitrosyl chloride and nitrosyl bromide have been determined by electron diffraction, the interpretation being made both by the radial distribution method and by the usual visual method. The following results were obtained—nitrosyl chloride: Cl–O = 2·65 ± 0·01 Å, Cl–N = 1·95 ± 0·01 Å, N–O = 1·14 ± 0·02 Å, angle Cl–N–O = 116 ± 2°; nitrosyl bromide: Br–O = 2·85 ± 0·02 Å, Br–A = 2·14 ± 0·02 Å, N–O = 1·15 ± 0·04 Å, angle Br–N–O = 117 ± 3°. The surprisingly large halogen-nitrogen distances found are explained as caused by resonance between the normal covalent structure and the ionic structure. AUTHORS.

403. Molecular Interactions and Chemical Affinity. P. Girard and P. Abadie. *J. de Physique et le Radium*, 8. *pp*. 439–445, *Nov*., 1937.—Interaction between dipoles of the same kind, as well as that between molecules of different kinds, one of which may be entirely devoid of moment is best studied as regards variations in time of relaxation by means of data obtained from Hertzian dispersion. This shows that besides the factors affecting interaction connected with the van der Waals forces, there are two other important factors: (1) that in some molecules all the valences of C are not satisfied, and (2) the chemical affinity existing between two kinds of molecules. [See Abstracts 2338 (1935) and 1436 (1936).] C. A. S.

404. Molecular Interaction and Polarisability. A. Michels, J. de Boer, and A. Bijl. *Physica*, 4. *pp* .981–994, *Nov*., 1937. *In English*.—An attempt is made to draw some theoretical conclusions from previously published isothermal data for N_2 between 10 and 3000 atm. [see Abstract 3455 (1936)] and from new measurements by Michels and Wouters for He. The experimental energy of interaction between two molecules of He is compared with that derived by calculation using expressions of Margenau and of Slater and Kirkwood. For the more complicated N_2 molecule, for which wave-mechanical calculation for the total interaction energy is not yet available, use is made of Lennard-Jones' expression for this, calculated values being in fair agreement with those obtained experimentally. The effect of pressure on the kinetic energy and polarisability of molecules of CO_2 and N_2 is then discussed. A study of earlier results for the dielectric constant of CO_2 reveals an apparent connection between the effects of pressure on the kinetic energy of the molecules and on the Clausius-Mossotti function, which suggests that a change of polarisability results from intramolecular changes. The CO_2 molecule is too complex for theoretical treatment, but by considering the polarisability and kinetic energy as a function of distance for the simple case of two H atoms a very similar connection between these two quantities is obtained. R. W. P.

405. Anisotropy of Van der Waals Forces. J. H. de Boer. *Physica,* 4. *pp.* 1045–1055, *Nov.,* 1937. *In German.*—The orientation of molecules subjected to van der Waals forces of attraction results from two opposing effects (1) the resultant of the van der Waals forces which seek to so direct the molecules that each atom has as many neighbours as possible, and (2) the anistropy due to polarisability which tends to make the axes of strongest polarisability lie in the line of molecular bondage. In general (1) predominates, so that long molecules lie parallel to one another, ring shaped molecules are superimposed and so on. For diatomic molecules, however, there can be preponderance of (2), in which case the two molecules would lie in the direction of their common axes. The influence of a boundary wall is also considered. As an appendix **G. Heller** (*pp.* 1055-1057) applied London's theory for the van der Waals forces to anisotropic molecules. R. W. P.

406. London-Van der Waals Attraction between Spherical Particles. H. C. Hamaker. *Physica,* 4. *pp.* 1058–1072, *Nov.,* 1937. *In English.*—The adhesive forces which exist between small particles are considered to promote the flocculation observed in colloidal systems, and in order to obtain general information for the case where the particles are spherical, the London–van der Waals interaction is computed as a function of their diameters and distance apart. The results are tabulated and approximations given for use when the distance apart is small. The effect of both particles being immersed in a fluid is discussed, and it is concluded that even for this case the forces considered generally cause attraction. R. W. P.

407. Atomic Masses of the Heavy Elements. A. J. Dempster. *Phys. Rev.* 53. *pp.* 64–75, *Jan.* 1, 1938.—Comparisons have been made between a series of different atomic masses by means of a double-focussing mass spectrograph. The small displacement between the positions of multiply charged ions of one mass and atoms of another mass is measured and gives a value for the difference in the packing fractions of the two atomic masses. The following pairs of ions have been compared: O^+-Ti^{+3}, C^+-Ti^{+4}, N^+-Fe^{+4}, O^+-Cu^{+4}, Al^+-Ag^{+4}, Cu^+-Au^{+3}, Ti^+-Au^{+4}, Cu^+-Pt^{+3}, Sn^+-Th^{+2}, Sn^+-U^{+2}, Sn^+-AcU^{+2}, Zr^+-W^{+2}(91, 92), Mo^+-Pt^{+2} (96, 97, 98), Mo^+-Ir^{+2}, Pd^+-Pb^{+2}(102, 104), Rh^+-Pb^{+2}, Pd^+-Tl^{+2}, Pd^+-Bi^{+2}, Ru^+-Os^{+2}(96), Ru^+-Pt^{+2}(99), Pd-Ga^+. Less exact comparisons have also been made between the following pairs; Mo^+-Os^{+2}(94, 95, 96), Ag^{+5}-Zn^{+3}, Na^+-Zn^{+3}, Sn^+-Ta^{+3}, K^{+2}-Ru^{+5}, Ni^{+2}-Ru^{+5}, Al^+-Pd^{+4}, Fe^+-Ag^{+2}. The values deduced for the packing fractions of Ti, Fe and Cu, and the probable values for Zn, Ag, Au and Pt are higher than those to be expected from Aston's packing fraction curve by about 2 parts in 10,000. AUTHOR.

See also Abstracts 461, 499, 702, 707, 774, 775, 778, 794, 827.

COLLOIDS.

408. Influence of the Size of Colloidal Particles on their Optical Anisotropy. W. Heller. *Comptes Rendus,* 205. *pp.* 971–973, *Nov.* 22, 1937.—Experiments on the variation with wave-length of the dichroism and birefringence of colloidal Fe_2O_3 show that the two effects are displaced towards longer wave-lengths as the particle size increases. The results are compared with the dispersion of birefringence of V_2O_5 sols. C. B. A.

409. Anomaly in Elastic Behaviour of India Rubber. A. N. Puri. *Nat. Acad. Sci., India, Proc.* 7. 1. *pp.* 45–51, 1937.—The Young's modulus and rigidity for a sample of india rubber are determined. Young's modulus is measured both statically and dynamically. It is found that the dynamical value is about twice the statical value for all loads. The cause of this anomaly is observed but no satisfactory explanation has been found. AUTHOR.

410. Solvation of Rubber in Dispersion Media of Different Polarities. V. B. Margaritov. *Acta Physicochimica*, 6. 5. *pp.* 707–726, 1937. *In English.*—The "apparent fluidities" of solutions of natural rubber in various solvents are determined as functions of concentration and temperature between room-temperature and the freezing point of the solvent. Some solutions of a sodium divynyl polymer are also investigated. The observed changes of fluidity are associated with the disperse phase and solvated films. At the low rubber concentrations studied (0·1 to 2%) the temperature coefficients of apparent fluidity are high and it is observed that the gelation temperature is independent of the concentration. Experiments are also carried out upon the effect of the addition of small concentrations (less than 10^{-4} mol./l.) of polar substances (fatty acids) to 0·1% rubber sols in hexane. While greatly lowering the temperature coefficient of apparent fluidity, the polar additions produce no effect on the gelation temperature. The results are discussed in relation to the solvation of the disperse phase. L. A. W.

411. Colloidal Formations and Electrophoretic Phenomena on Metals. L. I. Beljajev. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 17. 3. *pp.* 103–106, 1937. *In English.*—The disperse phase of sols of gold, Prussian blue, etc., forms a microscopic film on metal surfaces. These films have structures corresponding to those of the metal surfaces, which can therefore be investigated indirectly by studying the films. Films at the interface Hg-H_2O move towards the anode under the influence of a constant field, this being supposed to be due to motion of the Hg surface. Water layers and surface formations at the interface between a metal and a liquid are also found to propagate and shift in an electric field. L. A. W.

412. Rhythmic Precipitation in Electric Field. Part II. T. Okaya and K. Ohmori. *Phys. Math. Soc., Japan, Proc.* 19. *pp.* 988–1002, *Nov.*, 1937. *In French.*—Using the previous notation $\beta_0 (= \bar{\beta} - kv)$, and t_n both vary much with temperature, and elaborate (completely empirical) expressions are deduced to show the connection. [See Abstract 4275 (1937).] C. A. S.

413. New Method for Producing Liesegang Rings in Gels. J. Obrist. *Kolloid Zeits.* 81. *pp.* 327–330, *Dec.*, 1937.—Difficulties and objections associated with the usual method for the production of Liesegang rings by diffusion on a horizontal plate are briefly reviewed. A method, employing a gel produced between two horizontal plates, the upper of which has a small central hole through which the second reacting component is introduced from a small tube resting on it, is described. The paper is illustrated by rings obtained by the periodic precipitation of $Mg(OH)_2$ by the diffusion of NH_3 into a $MgCl_2$ gel. J. S. G. T.

***414. High Rotational Speeds. J. W. Beams.** *J. of Applied Physics*, 8. *pp.* 795–806, *Dec.*, 1937.—A review of recent advances in the construction of various types of ultra-centrifuge. A. J. M.

415. Effect of Ultrasonic Waves on Colloidal Phenomena. Part IV. N. Sata and Y. Niwase. *Kolloid Zeits.* 81. *pp.* 294–300, *Dec.*, 1937.—The effect of purity of HgS on its peptisation was examined. Three stages of purity are recognised: (*a*) a substance which can be peptised by H_2S and ultrasonic waves, (*b*) a substance stable towards H_2S, but peptised by ultrasonic waves, (*c*) a substance stable towards both H_2S and ultrasonic waves. Very long boiling of HgS with water, and decantation of the precipitate, results in a structural change of the HgS which influences the ease with which peptisation occurs. [For Part III see Abstract 27 (1938).] A. J. M.

See also Abstracts 406, 832, 833, 834, 869, 870.

CRYSTAL STRUCTURE AND SPECIAL PROPERTIES.

416. Calculation of Interplanar Spacings of Crystal Systems by Vectors. S. S. Sidhu. *Indian Journ. Phys.* 11. *pp.* 349–357, *Dec.*, 1937.—Expressions for the calculation of interplanar spacings of crystal systems: cubic, simple tetragonal, simple orthorhombic, hexagonal, simple monoclinic, triclinic and rhombohedral have been derived by vectors. This is shown to be much briefer and simpler than the analytical methods generally employed at present for these derivations. AUTHOR.

417. Method of Measuring the Internal Periodic Potential of Crystals. A. Hautot. *Comptes Rendus*, 205. *pp.* 1161–1163, *Dec.* 6, 1937.—The author has succeeded in photographing at tensions between 21 and 46 kV the diagrams of electronic diffraction obtained with two metals, Ni and Au, when a beam of electrons was caused to fall upon crystals of the substances. The fine diffraction rings were also photographed for two semiconductors, graphite and Cu_2O. The section of the incident electronic beam was of the order of 0·01 mm. and the diffraction rings were scarcely wider than this. From these measurements there is obtained by Kikuchi's formula, $V_{\alpha\beta\gamma} = 2E\theta\Delta\theta$, the order of magnitude of the terms $V_{\alpha\beta\gamma}$ measuring the fluctuations of potential in the interior of the crystal; E being the energy of the electrons, θ Bragg's angle relative to the plane of the crystal considered, and $\Delta\theta$ the angular width of the corresponding diffraction ring. [See Abstract 2734 (1935).] J. J. S.

418. Irrational Diffractions Obtained in Transmission of Fast Electrons Through Small Crystals. F. Kirchner and O. Rüdiger. *Ann. d. Physik*, 30. 7. *pp.* 609–615, *Dec.*, 1937.—Kirchner and Lassen [see Abstract 5210 (1935)] showed that thin metal films, when formed at elevated temperatures, consist of perfectly oriented crystals with their cube-faces parallel to the substrate and give rise to irrational diffractions. It is now shown that irrational diffractions also occur when octahedral faces are parallel to the substrate and it is claimed that Laue's theory of crystal shapes cannot explain them. In reply **M. v. Laue** (*pp.* 616–618) criticises some of the authors' conclusions and points out that he has already emphasised that this theory does not claim to explain all cases of electron diffraction, but that it does explain many of the patterns already published. In a detailed counter-reply **Kirchner** (*pp.* 619–620), states that he has repeated for Ag, Brück's work on Au [see Abstract 2977 (1936)] in which it was shown that rotation of the film plane by 45° from the position affording irrational diffractions produced a pattern consisting solely of normal diffractions, and this is interpreted as disproving the existence of periodical lattice faults. Further, Kirchner has found that with very small particle size no irrational diffractions occur and therefore Laue's suggestions that crystal shape varies with crystal size does not eliminate the difficulties arising in the application of Laue's theory to the latest results. A. G. Q.

419. Critical Ordering Temperature in Alloys. Part II. C. E. Easthope. *Cambridge Phil. Soc., Proc.* 34. *pp.* 68–80, *Jan.*, 1938.—By using Bragg and Williams' approximations and Bethe's interaction energies between nearest neighbours, it has been shown that, for alloys of the AB_3 type, (1) the maximum value of the critical temperature T_c must occur when $c = \frac{1}{2}$, (2) for all temperatures within the range $0 < T < (T_c)_{max}$ there is always a concentration range within which the alloy exists in a two-phase state, the one phase being partially ordered and the other disordered. This two-phase region is small at all temperatures and vanishes both at $T = 0$ and at $T = (T_c)_{max}$. In particular for $T/T(_c)_{max} = 0 \cdot 82$, which is the value of T_c for $c = \frac{1}{4}$, the limits of the two-phase region are $c = 0 \cdot 245$ and $c = 0 \cdot 256$. The theoretical phase diagram has therefore qualitatively the shape given in Fig. 5 of the original paper. For a fixed concentration there is thus a certain temperature range in which a disordered phase and a partially ordered phase exist in equilibrium with one another. The temperature at which the disordered phase completely disappears is that usually given by experimental determinations of the critical temperature. It is somewhat higher than T_c, but its maximum value also occurs when $c = \frac{1}{2}$, so that the discrepancy between theory and experiment for this type of superlattice still remains. [For Part I see Abstract 4798 (1937).] AUTHOR.

420. Lattice Changes Associated with the Formation of Superlattices in Alloys. A. H. Wilson. *Cambridge Phil. Soc., Proc.* 34. *pp.* 81–88, *Jan.*, 1938.—Bethe's theory of order and disorder in alloys is generalised so as to include transitions in which the lattice structure changes from cubic to tetragonal. It is shown that, with the assumptions made, there is a discontinuity in the order at the transition temperature and also a latent heat. An expression is derived for the degree of tetragonality as a function of the order. AUTHOR.

421. Crystal Structure and Ferromagnetism of Alloys. U. Dehlinger. *Zeits. f. Metallkunde*, 29. *pp.* 388–395, *Nov.*, 1937.—The magnetic properties of the more important alloy systems are summarised and a number of general rules are formulated. Ferromagnetism is only to be expected in alloys containing Cr, Mn, Fe, Co and Ni; the effect of any alloy component on the saturation moment and Curie temperature is only appreciable if it is present in a fairly concentrated amount, but small additions may considerably alter the coercive force and remanence. The effects of thermal treatment on the coercive force are enumerated; the highest coercive force is obtained with alloys which have a high saturation moment and which transform easily. The presence of Co and Ni tends to give relatively small saturation moments which are, however, almost independent of the particular crystal structure; in alloys of this type, relations are found between the exchange interval and the saturation moment. High saturation moments are found in alloys containing Fe, Mn and Cr if the density of packing of these elements in the lattice is not too great. The density of packing depends on a number of factors which are given. Certain regularities in ternary alloys and in transitional metals are pointed out, especially in relation to the Hume-Rothery Rule. H. J. H. S.

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422. Structure of Uranium. C. W. Jacob and B. E. Warren. *Am. Chem. Soc., J.* 59. *pp.* 2588–2591, *Dec.*, 1937.—X-ray powder patterns of U lead to an orthorhombic unit cell with axes $a = 2\cdot852$, $b = 5\cdot865$, $c = 4\cdot945$ Å. The space group is V_h^{17} *Cmcm.* and there are four atoms in the position 4c. The parameter is determined from the intensities as $y = 0\cdot105 \pm 0\cdot005$. The X-ray density is 18·97. The structure can be considered as a deformed hexagonal close-packed structure with four neighbours closer than the other eight. The structure suggests that U is only pseudo-metallic. AUTHORS.

423. Superstructures in Alloy Systems. F. C. Nix. *J. of Applied Physics*, 8. *pp.* 783–794, *Dec.*, 1937.—A critical review of the present position, under the following heads :—1. Current theories of the superlattice. 2. Methods of measuring the degree of order : (*a*) electrical conductivity ; (*b*) magnetic susceptibility ; (*c*) intensity of X-ray reflection lines ; (*d*) lattice constants. 3. Effect of order on resistivity, Cu-Au and Cu-Pd systems. 4. Effect of order on mechanical properties. 5. Effect of order on magnetic properties : (*a*) dia- and para-magnetic alloys. Additions of strongly paramagnetic Pd increase the weak diamagnetism of Cu, Ag, Au, up to about 30% Pd ; (*b*) non-ferrous ferromagnetic alloys. Cu_2 Al Mn (Heusler's), Sn-Mn, Sb-Mn alloys ; (*c*) ferrous ferromagnetic alloys. Fe-Pd, Fe-Pt, Fe-Ni-Al (Mishima) alloys. 6. Effect of cold-work on order. Ni_3 Fe, Ni_3 Mn. D. R. H.

424. Structure of Boron Nitride. A. Brager. *Acta Physicochimica*, 6. 5. *pp.* 699–706, 1937. *In English.*—BN prepared at 1100° and at 2000° C. is investigated by the powder method with Cu antikathode working at 30 kV and 10 mA with 12 hr. exposure. Identical results are obtained. From the date of O. Hassel (*Norsk Geologisk Tidskrift*, *pp.* 266–270, 1926), that $a = 2\cdot51$, $c = 6\cdot69$ Å, two B atoms are found to exist at $\frac{1}{3}, \frac{2}{3}, 0$ and two N atoms at 0,0,0 and $0,0,\frac{1}{2}$ in the unit cell ; space group C_{3h}. D. R. H.

425. Two-Dimensional Crystals of Silica. N. A. Shishacow. *Acta Physicochimica*, 6. 5. *pp.* 727–736, 1937. *In English.*—Experiments are described which negative the suggestion that the electronic diffraction rings of vitreous silica and pumice which indicate a structure similar to that of high temperature cristobalite, are really due either to organic impurity, or to a film of hydrous silica. Most puzzolanas give a diagram similar to that of vitreous silica, as also do (save for absence of some extra rings, probably due to the presence of the third dimension, in the crystals of vitreous silica) several clay minerals. These diagrams are best explained on the assumption of a hexagonal lattice ($a = 5\cdot161$), the crystal being either oriented so that their basic planes are parallel to the supporting celluloid film, or two-dimensional. Arguments in support of the latter view are then adduced. The reasons for the similarity of the diagrams is probably that the clay minerals are decomposed by the kathode rays with separation of Al_2O_3 and of two-dimensional crystals of composition Si_2O_5. C. A. S.

426. Structure of Potassium Dihydronium Pentaborate, $KH_2(H_3O)_2B_5O_{10}$. W. H. Zachariasen. *Zeits. f. Krist.* 98. 3. *pp.* 266–274, 1937. *In English.*—The above compound is usually given the formula KB_5O_8, $4H_2O$ but this investigation shows that the correct formula is $KB_5O_{10}H_2\cdot(H_3O)_2$. The orthorhombic crystals have the following unit cell dimensions, etc., $a = 11\cdot08$ Å, $b = 11\cdot14$ Å, $c = 8\cdot97$ Å ; 4 mol. per unit cell ; probable space group = A*ba* (C_{2v}^{17}). The structure contains

B_5O_{10} complexes with a BO_4 tetrahedron as the nucleus and 4 BO_3 triangles. The distance B–O in the tetrahedron is 1·53 Å and 1·36 Å in the triangular groups. The average distance of the K atom from its eight O neighbours is 2·92 Å. The O atoms not linked to B atoms appear to be arranged with the H atoms to form hydronium ions which are linked to three O atoms by weak hydroxyl bonds and to one K atom each. J. I.

427. Liquid Crystals Obtained by Sublimation. P. Gaubert. *Comptes Rendus*, 205. *pp.* 997–998, *Nov.* 22, 1937.—The present investigation is concerned with the properties of an anisotropic liquid, *p*-azoxyanisole, obtained by sublimation. Brief experimental details are included. Almost all the anisotropic drops, on solidification, give fibres of an unstable crystalline form melting at 104°. At this temperature an homogeneous region is formed such that the anisotropic liquid phase has a more extended domain than if stable crystals had been produced. Under the conditions described, the unstable form has a longer life than in ordinary preparations. On heating, the liquid crystals conserve their optical properties as far as the isotropic fusion point, but the birefringence diminishes. The formation of spherulites in the neighbourhood of the fusion point is discussed. H. H. Ho.

428. Reciprocal Effect of Molecules in Anisotropic Liquids. W. Kast and W. Maier. *Physica*, 4. *pp.* 957–962, *Nov.*, 1937. *In German.*—The reciprocal effect of molecules in anisotropic liquids is discussed according to both the continuum theory and the swarm theory. W. R. A.

429. Polymorphism in Leucite. J. Wyart. *Comptes Rendus*, 205. *pp.* 1077–1079, *Nov.* 29, 1937.—The author has shown in a previous paper [see Abstract 35 (1937)] that the apparently cubic habit of natural leucite crystals is due to their being composed of twinned tetragonal crystallites. The unit cell of this tetragonal lattice has the following dimensions: $a = 12{\cdot}95$ Å, $c = 13{\cdot}65$ Å. Heating causes the tetragonal lattice to disappear, the crystals becoming truly cubic and X-ray examinations of crystals at various temperatures show that this transition is a continuous process which becomes complete at 625° C. The axial ratio has the values, 0·70, 0·55, 0·45, 0·37, 0 at 20° C., 290° C., 440° C., 520° C. and 625° C. respectively. The *a* axis gradually increases and the *c* axis decreases until they are both 13·40 Å at 625° C. The transformation is exactly reversible and the change from tetragonal to cubic is, during the temperature interval 575°–625° C., accompanied by an absorption of heat and the reverse change from cubic to tetragonal shows also a corresponding loss of heat during the same temperature interval. These heat changes can be demonstrated only when the heating or the cooling of the crystal is rapid. J. I.

430. Crystalline Boric Oxide. L. McCulloch. *Am. Chem. Soc., J.* 59. *pp.* 2650–2652, *Dec.*, 1937.—Fused boric acid, held for days at 225–250° and retaining 8 to 15% water, was found to develop crystals, giving up its water and attaining finally the state of a stony solid. By " seeding " such a liquid, this change is induced to proceed immediately. This solid is essentially anhydrous boric oxide. The X-ray picture shows it to be crystalline. Its solubility curve is given. Its melting point is 460–470°, its density is 2·42. AUTHOR.

431. Production of Large Single Crystals of KBr for Optical Use. D. C. Stockbarger. *J.O.S.A.* 27. *pp.* 416–419, *Dec.*, 1937.—A method of producing large single crystals of LiF from the melt has been described, in which a pointed-bottom crucible containing the salt is lowered through a high temperature gradient region which embraces the freezing point. Due to the design of the furnace, the melt and crystal are stored in regions of relatively low temperature gradient. The temperatures of these regions are such that vaporisation is negligible and cracking of the crystal never occurs. Owing to its importance for infra-red work, the apparatus and method have been modified for the production of KBr single crystals. The crystals are clean and flawless and the cleavage surfaces retain their initial polish after several weeks of exposure to moist air. C. J. B. C.

432. Sugar Crystals. J. Schmutzer. *K. Akad. Amsterdam, Proc.* 40. 9. *pp.* 800–802, 1937. *In Dutch.*—Triangular crystals of cane sugar were obtained in the Sugar Testing Station of Pasoeroean (Java) by crystallisation from a solution which, daily for several weeks, was heated to 70° C. either with decolourising charcoal or with Hyflozel. The form of the crystals is nearly that of an isosceles right-angled triangle, the hypotenuse of which is the edge between the right sphenoid (110). The other edges of this triangle are formed by the intersection of the left sphenoid $(0\bar{1}1)$ with the faces in the prism zone. The faces in this prism zone are the pinacoid (100), the left sphenoid $(2\bar{1}0)$ and the prism (110). The optical properties of the crystals were also examined and found to be identical with those of ordinary cane sugar crystals. G. G.

433. Theory of Twin Formation. Part II. I. Schaacke. *Zeits. f. Krist.* 98. 3. *pp.* 211–232, 1937.—In the first section of this paper the theory developed in Part I is extended to the several point lattices, tetragonal, rhombohedral, hexagonal, etc. In the second section the author considers the twin crystal systems of Group II. [For Part I see Abstract 5185 (1937).] J. I.

434. Crystal Growth from Solutions. W. F. Berg. *Roy. Soc., Proc.* 164*A*. *pp.* 79–95, *Jan.* 7, 1938.—An optical method of measuring the concentration distribution round a growing crystal is described. The flow of molecules at every point of the crystal surface can be determined. The results obtained on sodium chlorate are: (1) The concentration is not constant over all the crystal surface, but is highest at the corners. (2) The existence of an adsorbed layer on the crystal surface and a lateral flow of molecules in this layer must be assumed. (3) There is a hitherto unexplained effect influencing the transition of molecules from the solution into the different parts of the adsorbed layer. The influx is smaller at the corners than at the centres of the faces, although the concentration of the solution is higher on the corners. AUTHOR.

435. Effect of a Groove on the Strength of Rock-Salt. Part II. A. W. Stepanow. *Phys. Zeits. d. Sowjetunion,* 12. 4. *pp.* 343–359, 1937. *In English.*—A method for lowering the practical strength of rock-salt crystals is described. The weakening at rupture is achieved by creating conditions facilitating the appearance of the harmful effect of plastic deformation. Plastic deformation is facilitated by cutting the sample oriented in the [100] direction with a deep groove such that the plane of the groove coincides with a slip plane. The strength of samples of rock-salt oriented in the [100] direction and having an inclined groove the plane of which coincides with the slip plane was lower than that of ungrooved samples. In this way it was possible to obtain strengths as low as 80 gm./mm^2. as compared with the strength of ungrooved samples of 500 gm./mm^2. Rupture takes place in the thick part and not in the groove and the plane of rupture coincides with a cleavage plane. A preliminary study has been made of the effect of the following factors on the strength of ungrooved samples: (*a*) Type of groove. (*b*) Angle of inclination of groove. (*c*) Depth of groove. (*d*) Solution erosion of groove. (*e*) Temperature of the experiment. (*f*) Crystallographic orientation. [For Part I see Abstract 5189 (1937).] AUTHORS.

✱**436. Precision Powder Camera for Use at High Temperatures and a Measuring Apparatus for X-Ray Photographs. F. Schossberger.** *Zeits. f. Krist.* 98. 3. *pp.* 259–265, 1937.—The author gives details of the construction of an X-ray camera for taking Debye-Scherrer photographs. The camera is so constructed that the specimen holder is of necessity on the axis of the cylindrical film. The specimen can be heated and enclosed in an evacuated box and a mechanical device allows as many as 8 photographs to be taken without lowering the vacuum. A thermo-element is included in the design in order to measure the temperature of the specimen. The author also describes an apparatus for measuring the radii of Debye-Scherrer rings with an accuracy of 0·01 mm. J. I.

✱**437. New Focusing Method for X-Ray Powder Spectroscopy. L. K. Frevel.** *Rev. Sci. Instruments,* 8. *pp.* 475–477, *Dec.,* 1937.—A convergent Soller type slit, adaptable to a camera of arbitrary radius, serves to select those pencils of X-rays which emanate from a broad focal spot and impinge upon any selected point on the equator of the cylindrical camera. The diffracting powder is mounted on the camera wall in the form of a thin sheet which intercepts the wedge of X-radiation. In this manner all X-rays diffracted at the same Bragg angle are brought to a focus at the equator of the camera. AUTHOR.

See also Abstracts 439, 719, 736, 760.

DENSITY.

438. Physical Constants of Krypton. E. Mathias, C. A. Crommelin, and J. J. Meihuizen. *K. Onnes Lab., Leiden, Comm. No.* 248b. *Physica,* 4. *pp.* 1200–1211, *Dec.,* 1937. *In French. Ann. de Physique,* 8. *pp.* 467–483, *Dec.,* 1937.—The krypton was purified by double fractional distillation, followed by rectification according to the method of H. v. Dijk, J. Mazur, and W. H. Keesom [see Abstract 713 (1934)]. The densities at various temperatures of the liquid and of the saturated vapour are measured. At the critical temperature the rectilinear diameter gives a value of $\Delta = 0{\cdot}9085$ for the critical density. The equation $y = 1{\cdot}3290 + 0{\cdot}002382\ \mathrm{T} - 3{\cdot}8104 \times 10^{-5}\ \mathrm{T}^2 + 8{\cdot}3 \times 10^{-8}\ \mathrm{T}^3$, where T is the absolute temperature, represents very exactly the real rectilinear diameter, and leads to a value of $\Delta = 0{\cdot}9191$. The curvature of this diameter is also measured. The latent heat of vaporisation is also calculated; it is found to be given by $\mathrm{L} = 0{\cdot}01896\ \mathrm{T}\sqrt{\mathrm{T}_c - \mathrm{T}} + 0{\cdot}3837\ \mathrm{T} - 0{\cdot}004346\ \mathrm{T}^2 + 1{\cdot}212 \times 10^{-5}\ \mathrm{T}^3$. The so-called internal and external latent heats of vaporisation are also given, as also the differences between the two specific heats. G. G.

✱**439. Precision Pyknometric Method for Liquids and Solids. T. Batuecas and F. L. Casado.** *Zeits. f. phys. Chem.* 181. *Abt. A.* 3. *pp.* 197–207, 1937.—The pyknometer previously described and used for determining the density of mercury [*J. Chim. Physique,* 33. *p.* 41, 1936] has been used for determining the densities at 0° C. of purest toluene, clear calcite, NaCl, Mg and Al. The following are the values found: toluene $0{\cdot}88548_2 \pm 0{\cdot}000003$ gm./ml.; calcite (Island), $2{\cdot}7112_8 \pm 0{\cdot}0001_1$ gm./cm.^{3};

NaCl, $2 \cdot 1675_6 \pm 0 \cdot 0001_2$ gm./cm.^{3}; Mg, $1 \cdot 7407 \pm 0 \cdot 0002$ gm./cm.^{3}; Al, $2 \cdot 7015 \times 0 \cdot 0003$ gm./cm.^{3}. The following values of the lattice constants of calcite and NaCl at 0° C. are calculated from the respective results $D_{CaCO_3} = 3 \cdot 0276 \times 10^{-8}$ cm.; $D_{NaCl} = 2 \cdot 8120 \times 10^{-8}$ cm. The ratio of these values, *viz.*, 1·0767, agrees well with the value, 1·0768, found by Compton, Beets and de Foe [see Abstract 1815 (1925)]. J. S. G. T.

See also Abstracts 395, 430, 679.

DIFFUSION AND OSMOSIS.

440. Dependence of Diffusion Coefficients on Concentration of Diffusing Metals. V. Bugakov and B. Sirotkin. *Techn. Phys., U.S.S.R.* 4. 7. *pp.* 537–544, 1937. *In German.*—The diffusion of Cd and Zn in Ag at different concentrations of the metals was investigated. In the case of Cd diffusing into Ag, the diffusion coefficient is approximately constant for concentrations of Cd up to 5%, but from 5–10% it increases considerably, the increase being greater the higher the temperature. The coefficient is a little less at 15% of Cd than at 10%. For the diffusion of Zn in Ag the diffusion coefficient is constant up to a concentration of 10% of Zn. The variation in the upper concentration limit of the constant diffusion coefficient depends on the atomic radius of the diffusing metal. A. J. M.

441. Mutual Diffusion of Iron and Zinc. V. Bugakov. *Techn. Phys., U.S.S.R.* 4. 7. *pp.* 545–555, 1937. *In German.*—The effect of the substratum on the nature of the diffusion layer has been investigated microscopically for steels of different compositions coated with iron. There was a considerable difference in the structure of the layer for steels containing 0·15, 0·5 and 0·9% C., respectively, and there were also differences depending on the temperature of dipping. The diffusing layer depends on the structure of the steel, and not merely on the C. content, except in so far as this determines structure. A. J. M.

442. Search for Ionisation of Hydrogen by Diffusion Through Palladium. R. G. Stansfield. *Cambridge Phil. Soc., Proc.* 34. *pp.* 120–123, *Jan.*, 1938.—No ionisation was found in H_2 leaving Pd, either when the gas diffused through the metal or was evolved by warming Pd previously charged with H_2 by electrolysis in dilute H_2SO_4. AUTHOR.

443. Transmission of Gases through Capillary Systems. E. Manegold. *Kolloid Zeits.* 81. *pp.* 269–294, *Dec.*, 1937.—Results of experiments on the transmission of gases through cellulose- and cellulose ester-membranes, leather, silica gel, sandstone, artificial stone, and similar substances are given. The specific transmissibility is a very characteristic quantity, depending on the internal structure of the capillary system. A. J. M.

See also Abstracts 460, 795, 875.

ELASTICITY AND PLASTICITY.

444. Frequencies and Nodal Systems of Circular Plates. R. C. Colwell and H. C. Hardy. *Phil. Mag.* 24. *pp.* 1041–1055, *Dec.*, 1937.—Values of the numerical constant in the frequency formula are given for up to 10 nodal diameters and 6 nodal circles, for a circular plate with a free edge. The radii of the nodal circles were also calculated, and compared with experiment. W. G. B.

445. Deflection of Thin Rectangular Plates Clamped at the Edges and Uniformly Loaded. B. C. Laws. *Phil. Mag.*, **24.** *pp.* 1072–1082, *Dec.*, 1937.—Mainly on account of the consequence of the stretching of the deflected plate, it is expected that theory will give a maximum deflection in excess of the experimental value. This is confirmed, and experimental results lead to a formula $\delta = \{6n^4/(7n^4 + 12\cdot5)\}(wb^4/32Et^3)$ (n = ratio of sides, w = load/unit area, b = shorter side, E = Young's modulus, t = thickness). W. G. B.

446. Calculation of Maximum Deflection, Moment and Shear for Uniformly Loaded Rectangular Plate with Clamped Edges. I. A. Wojtaszak. *J. of Applied Mechanics*, 4. *A*173–*A*176, *Dec.*, 1937.—The problem of the uniformly loaded rectangular plate with four clamped edges has been solved by H. Hencky and independently by J. Boobnoff. Hencky made refined calculations only for the case of a square plate while Boobnoff made precise calculations for several ratios of the sides of the plate. This article gives the results of calculations for maximum deflection, moment and shear for several ratios of the sides of the plate, using Hencky's equations. Curves are drawn with the coefficients, used in defining these maximum quantities, as ordinates and the ratios of the sides of the plate as abscissæ. AUTHOR.

447. Stability of a Clamped Elliptic Plate Under Uniform Compression. S. Voinovsky-Krieger. *J. of Applied Mechanics*, 4. *A*177–*A*178, *Dec.*, 1937.—The energy criterion of stability, investigated by G. N. Bryan and S. Timoshenko, has been applied with great success to numerous problems of buckling of thin elastic plates submitted to compressive or shearing forces in their own plane. The cases discussed up to the present have concerned almost exclusively rectangular plates, this form of the plate being practically the most important. The application of the energy method to plates bounded curvilinearly will now be illustrated by the case of the elliptic plate. AUTHOR.

*448. **Distortion of the Photoelastic Fringe Pattern in an Optically Unbalanced Polariscope. R. D. Mindlin.** *J. of Applied Mechanics*, 4. *A*170–*A*172, *Dec.*, 1937.—This paper describes the results of an investigation of the effect of inaccuracies in the two quarter-wave plates of a photoelastic polariscope on the configuration of the monochromatic fringe pattern. It is shown that the fringe pattern is distorted to an extent which depends upon the orientations of the axes of principal stress and the difference between the retardations of the two plates. AUTHOR.

449. Periodic and Aperiodic Oscillations in Sensitive Regulators. H. König. *Zeits. f. techn. Physik*, 18. 11. *pp.* 426–431, 1937.—Deals in a general manner with the investigation of the performance of regulators, and with methods of increasing the stability of a given system. P. H. B.

See also Abstracts 435, 452, 504, 505.

328B. Recent Research in Elasticity. J. N. Goodier.

329B. Recent Investigations in Plastic Torsion. C. W. MacGregor and J. A. Hrones.

351B. Electrochemical Study of Deformation of Metals. L. V. Nikitin.

484B. Bending of Beams on Elastic Foundations. R. T. Coe.

GRAVITATION.

*450. **Series of Values of 'g' about a Given Station. A. Guillet.** *Comptes Rendus*, 205. *pp.* 1123–1125, *Dec.* 6, 1937.—A pendulum device comprising two masses which can be separated from one another while the position of their centre of gravity remains fixed is suggested for the measurement of variations of g at different stations. J. S. G. T.

451. Gravity Anomalies from Deflections of the Vertical. H. Jeffreys. *Roy. Astron. Soc., M.N., Geophys. Supplement,* 4. *pp.* 313–314, *Jan.,* 1938.—The paper shows how to determine the disturbance of gravity from empirical determinations of the form of the level surface. W. A. R.

HYDRODYNAMICS AND AERODYNAMICS.

452. Asymmetry of the Stress Tensor. S. Fujiwhara. *Geophys. Mag., Tokyo,* 11. *pp.* 177–184, *Sept.,* 1937. *In English.*—At a discontinuity the stress tensor need not be symmetric. The asymmetry gives rise to microgyrostatic motion at the discontinuity. W. G. B.

453. Experimental Study of Two-Dimensional Fluid Motion. A. Favre. *Comptes Rendus,* 205. *pp.* 956–958, *Nov.* 22; 1126–1128, *Dec.* 6, *and pp.* 1211–1213, *Dec.* 13, 1937.—Investigations of the effects of angle of incidence, tunnel height and wind velocity upon the pressure exerted upon a model Joukowski aileron show that circulation in a Toussaint Carafoli tunnel is influenced by the horizontal walls of the tunnel. This effect is investigated, and it is shown that a good approximation to two-dimensional flow, without circulation, is possible within the tunnel; corrections for taking circulation into account are derived. Further study is carried out more especially to establish the orders of magnitude of the principal functions occurring in the hydrodynamical equations and to ascertain the order of magnitude of viscous and inertial terms in the Navier-Stokes equations. Illustrations of flow past a Joukowski aerofoil (430) in a tunnel at various distances (3·7–20 m.m.) from the horizontal walls of the tunnel, for various angles of incidence and velocities ranging from 98 to 202 cm./sec. are given. J. S. G. T.

454. Fluid Motion Devoid of Acceleration. E. Merlin. *Comptes Rendus,* 205. *pp.* 1128–1130, *Dec.* 6, 1937.—The motion of fluid, each particle of which retains its respective initial density and moves with constant velocity, both in magnitude and direction, is discussed. The motion of the fluid is derived by establishing a correspondence between points on an indicatrix surface, I, of constant velocity and lines on a congruence, G, of plane lines which move as though they were rigid. J. S. G. T.

455. Verification of Stokes' Theory of a Sphere Oscillating in a Liquid. D. S. Subrahmanyam. *Indian Journ. Phys.* 11. *pp.* 305–317, *Dec.,* 1937.—A float is constructed of a hollow sphere and a fine uniform stem and made to oscillate in water, the sphere being under water and the stem passing through the surface. From the period and logarithmic decrement of the float, the virtual mass of the sphere is calculated which is found to be in good agreement with the value obtained by Stokes' theory. Secondly, assuming Stokes' theory to be true, the coefficient of viscosity of water is calculated which again is found to agree with the capillary flow value, when correction is made for the damping due to the stem. Thus Stokes' theory of a sphere oscillating in a liquid is fully verified. AUTHOR.

456. Partition of the Energy Dissipated in the Turbulent Flow of an Incompressible Fluid. J. K. de Fériet and A. Martinot-Lagarde. *Comptes Rendus,* 205. *pp.* 1208–1210, *Dec.* 13, 1937.—The energy dissipated in the turbulent flow of an incompressible fluid through a cylindrical tube is analysed into its two constituents, *viz.*, that dissipated in the mean motion and that dissipated in the motion of agitation. The results are applied to the case of very rough and very smooth cylindrical tubes of circular cross-section. In the latter case the dissipation of energy of mean motion occurs principally within a narrow region adjacent to the wall of the tube, and the energy dissipated by agitation increases with increase of Reynolds number while remaining throughout of the same order of magnitude as that dissipated in the mean motion. J. S. G. T.

457. Statistical Theory of Isotropic Turbulence. T. de Kármán and L. Howarth. *Roy. Soc., Proc.* 164*A. pp.* 192–215, *Jan.* 21, 1938.—In this paper a general theory of isotropic turbulence is developed. The correlation coefficients between two arbitrary velocity components at two arbitrary points form a tensor called the correlation tensor. Due to isotropy the tensor corresponding to one fixed and one variable point has spherical symmetry; due to the condition of continuity it is completely determined by one scalar function. The mean products of the derivatives of the velocity fluctuations are expressed by the derivatives of the tensor components; in this way laborious calculations for obtaining such mean values are eliminated. The correlations between three components (triple correlation) is discussed. After developing the kinematics of isotropic turbulence the dynamical problem of the change of the various mean values with time is considered. It is shown that using the equations of motion a partial differential equation connecting the double and triple correlation functions can be established. The solution of this equation is investigated first in the case when the triple correlation is neglected and the shape of the double correlation function remains similar and only its scale changes. Equations for the dissipation of energy and vorticity are deduced. Finally, a possible solution for large Reynolds' numbers is given and applied to Taylor's problem of the decay of turbulence behind a grid. Taylor's fundamental relation between the width of the correlation function and the size of the small (dissipative) eddies is confirmed. However, it is believed that the linear law for the reciprocal of the root-mean-square of the velocity fluctuations as a function of the distance from the grid is a special case; in the last section of the present paper a more general functional relation is suggested. AUTHORS.

458. Resistance to Flow of a Gas in a Smooth Circular Pipe of Constant Cross-Section. V. Lelchuk. *Techn. Phys., U.S.S.R.* 4. 8. *pp.* 592–621, 1937. *In German.*—The resistance to the flow of superheated steam through a thermally insulated pipe was investigated experimentally with velocities of flow comparable with the velocity of sound and at Reynolds numbers between $2\cdot5 \times 10^5$ and 8×10^5. The steam entered the test length of pipe (inner diameter 20 mm., length 1500 mm.) at a pressure of 6 atm. The velocity was altered from 280 m./sec. to 600 m./sec. the velocity of sound being reached at the end of the pipe. An 'inlet' length between 26 and 35 diameters was found necessary. The influence of entry conditions was studied, pressure measurements being made with a rounded entry, a sharp entry, and an artificially constricted entry. The type of entry has little effect except on the 'inlet' length. The local resistance coefficient λ at any section of the pipe is found not to depend on the ratio of the velocity to the velocity of sound, and to depend on the Reynolds number in the same way as for an incompressible fluid. From the constancy of λ the pressure drop along the pipe can be calculated. S. G.

459. Velocity Fluctuations in a Boundary Layer before and after Transition to Turbulent Motion. G. Broersma. *K. Akad. Amsterdam, Proc.* 40. 9. *pp.* 784–791, 1937.—By means of hot wire anemometers the velocity fluctuations at two points in the boundary layer along a glass plate in a wind-tunnel were recorded, the main speed being so chosen that one point is in the laminar layer and the other in the turbulent. It was hoped to discover some definite correlation between the fluctuations, but the evidence for this is so far by no means conclusive. It is definitely shown, however, that at any distance from the plate the average (mean square) of the fluctuations is much greater in the turbulent than in the laminar region. With regard to the average frequency of the fluctuations, the results point to an increase of frequency with increasing distance from the plate. Further work is needed, however, before more definite results can be expected, and this is being planned. W. G. B.

See also Abstracts 414, 762, 801.

KINETIC THEORY OF MATTER.

460. Efflux of Gases Through Orifices. B. V. Korvin-Kroukovsky. *Frank. Inst., J.* 225. *pp.* 81–93, *Jan.*, 1938.—The efflux of gases through orifices was treated heretofore on the basis of adiabatic expansion, postulating the decrease of temperature, which is not observed in the facts of everyday experience. The consideration of molecular motion on the principles of the kinetic theory of gases shows the possibility of the expansion of a gas flowing through an orifice without change of temperature, and permits the formation of simple quantitative relations which are in satisfactory agreement with test data. For small difference in pressure the new expression for discharge becomes identical with Fliegner's formula. It is explained that reduction of temperature postulated by adiabatic formulæ should be understood to apply to the observer moving with stream, and that no change of temperature is registered by a stationary observer. The possibility of extension of the adiabatic and of the new " kinetic " formulæ to the pressure ratios below critical is opened by the consideration of reduced number of impacts between molecules with reduction of the pressure ratio. AUTHOR.

461. Experiments with Models to Determine the Ordinal State of Molecules in Liquids and in Gases of High Density. H. Rehaag and H. A. Stuart. *Phys. Zeits.* 38. *pp.* 1027–1031, *Dec.* 15, 1937.—The ordinal state of a liquid is determined by its density, temperature, and van der Waals forces. Such a molecular force field, however, is very complicated and in general impossible to evaluate except by approximations with models. The present paper contains a comprehensive account of experiments made with such models to determine the distance and orientation distribution of the particles. The account of the experiments, however, is so full of detail that the paper should be consulted in its entirety. H. H. Ho.

MASS.

***462. Simple Spring Torsion Balance. A. C. Fabergé.** *Journ. Sci. Instruments*, 15. *pp.* 17–21, *Jan.*, 1938.—A simple and inexpensive spring torsion balance is described, the elastic element of which is a helical spring of phosphor-bronze wire which is arranged to act as the only support of the torsion arm. The relative sensitivity is about 0·002 of the maximum load, while the absolute sensitivity attainable is at least 0·001 mg., by direct reading. AUTHOR.

MATHEMATICAL METHODS AND THEORY OF MEASUREMENTS.

463. Differentiation of Line Integrals by Parallel Displacement. W. S. Kimball. *Phil. Mag.* 25. *pp.* 1–45, *Jan.*, 1938.—[See also Abstract 498 (1937).]

464. Correlation of Multidimensional Chance Variables. T. Lindblad. *Sci. Scien. Fennica, Acta,* 2. 10. [81 *pp.*], 1937. *In German.*—This important and comprehensive mathematical paper contains 4 chapters with 22 sections. Chapter I gives a short treatment of the two-dimensional case, followed in Chapter II by the multidimensional theory. In §§ 5–9 of Chapter II, the probability functions, the different forms of combination, and correlation characteristics are discussed, while in §§ 10–12 a representation of the variables is given by means of standards, the reduced variables are defined, and the relations between their characteristics and those of the original variables are clearly laid down. Two new correlation magnitudes are defined, and in § 13 the relations between the combination of the original and standard variables are established, and utilised later for the calculation of the probable values and average error of the empirical characteristics. Finally in §§ 14–15 a representation of the normal correlation is given. Chapter III contains a discussion of some important problems for the practical application of the correlation theory. Methods are now derived for the first time for the determination of the probable values and average error of an empirical correlation characteristic, and then applied to different characteristics. In this chapter also are discussed the problems of the practical application of average dispersion and the correlation relationships of geometrical distributions. Chapter IV is devoted to an example of use of the correlation theory, *viz.*, the dependence of the average day temperature on temperature observations. H. H. Ho.

465. Units used by Various Authors in Chemical Physics and Physical Chemistry. K. Butkow. *Phys. Zeits. d. Sowjetunion,* 12. 4. *pp.* 485–488, 1937. *In German.*—The author cites numerous examples from papers and standard text-books of various units used by writers of many different countries which are wrong dimensionally. He then advances an appeal for greater attention to be given in schools to the study of the fundamentals of physical chemistry. H. H. Ho.

***466. Mechanical Solution of Algebraic Equations. H. C. Hart and I. Travis.** *Frank. Inst., J.* 225. *pp.* 63–72, *Jan.*, 1938.—The paper describes a machine for determining the real and complex roots of higher-degree algebraic equations. The principle of operation is found in the correspondence between sine wave quantities and complex numbers. The particular machine is designed for equations of the eighth degree, and finds all the roots with engineering accuracy in the space of a few minutes. Though designed primarily with a view to determining the indicial admittance of electric networks, the machine should find utility in other fields of applied mathematics as well. AUTHORS.

See also Abstracts 416, 582, 886.

MECHANICS, CLASSICAL.

See Abstract 658.

MECHANICS, QUANTUM.

467. Quantum Mechanics of Systems of Electrified Particles. J. Solomon. *Comptes Rendus*, 205. *pp.* 1040–1042, *Nov.* 29, 1937.—Non-relativistic quantum mechanics applied to the motion of N massive charged particles leads to the following results: (1) observation of the position of any one particle does not affect in any way the *simultaneous* observability of another particle; (2) the quantum mechanics of the centre of gravity of the particles is in no way different from customary quantum mechanics; (3) the incidence of a light beam upon the system leads directly to the deduction of the principle of indeterminacy. The theory of relativity introduces modifications into the theory except in the case when the particles are widely separated. J. S. G. T.

468. Passage of Vector Magnitudes to the Corresponding Spinors by the Conception of "Sub-Spaces." Interpretation of Dirac's Equations. J. Roubaud-Valette. *Comptes Rendus*, 205. *pp*. 1136–1139, *Dec*. 6, 1937.

469. Quantum Theory of LiH^+. G. S. Gordadse. *Phys. Zeits. d. Sowjetunion*, 12. 4. *pp*. 426–434, 1937. *In English*.—The system LiH^+ is examined by the numerical variation method which was used by the author for the problem of three centres [see Abstract 1489 (1936)]. There is found to be quantum-mechanical instability of the given formation. The approximate investigation of this system within the limits of the theory of Heitler and London leads to the same instability of LiH^+. AUTHOR.

470. Penetration into Potential Barriers in Several Dimensions. P. L. Kapur and R. Peierls. *Roy. Soc., Proc.* 163*A*. *pp*. 606–610, *Dec.* 22, 1937.—The method of geometrical optics is discussed in application to the penetration of particles into regions of negative kinetic energy. It is shown that in the case of problems in more than one dimension which cannot be separated, it is generally possible to derive an upper limit for the probability of penetration, and that in special cases the method gives the actual value of this probability. AUTHORS.

471. Self-Consistent Field with Exchange for Calcium. D. R. Hartree and W. Hartree. *Roy. Soc., Proc.* 164*A*. *pp*. 167–191, *Jan.* 21, 1938.—Calculations of the self-consistent field, with exchange, have been made for Ca^{++}, and the results are given. Solutions of Fock's equations, without allowance for the perturbation of the core by the series electrons, have also been carried out for the $(4s)$, $(4p)$ and $(3d)$ states of Ca^+ and $(4s)^2$, $(4s)$ $(4p)$ ^3P and ^1P states of neutral Ca. Energy values for all these states have been calculated and are compared with the observed values; it appears that exchange effects have considerable influence on the relative strengths of binding of a $(4s)$ and a $(3d)$ electron, and so are significant from the point of view of the position of the beginning of the transition group of elements in the periodic table. Transition probabilities have also been calculated for the $(4s)$–$(4p)$ and $(3d)$–$(4p)$ transitions of Ca^+ and the $(4s)^2$–$(4s)$ $(4p)$ singlet transition of neutral Ca; these transitions all give lines of astrophysical interest, and absolute values of transition probabilities may have astrophysical applications. AUTHORS.

472. Eigen-Time in Classical and Quantum Mechanics. V. Fock. *Phys. Zeits. d. Sowjetunion*, 12. 4. *pp*. 404–425, 1937. *In German.* It is shown that in the Hamiltonian action integral of relativistic classical mechanics the eigen-time, τ, can be considered as an independent variable when the Lagrangian function is expressed in a form differing from that customarily employed. This eigen-time is introduced into Dirac's wave equation, and a method of integrating the equation is developed ; Cauchy's problem, relating to initial values of ψ, is discussed along the lines of this method. In addition, Pauli's application of the Wentzel-Brillouin method to Dirac's equation is generalised and simplified. The mixed densities R and R_ν discussed in positron theory are expressed in terms of the fundamental solution and the Riemann function of Dirac's equation. The physical significance of mixed densities is very briefly discussed.

J. S. G. T.

See also Abstracts **392, 393, 476, 606, 628, 854.**

PHILOSOPHY OF SCIENTIFIC METHOD.

473. Science and the Unobservable. H. Dingle. *Nature,* **141.** *pp.* 21–28, *Jan.* 1, 1938. *Supplement. Paper read before the Roy. Inst.*—The practice of modern physics implies that nothing must be included in our description of the universe that would not be observable if we had full control of all known means of observation. If we adopt the realistic view that the universe exists independently of our observation of it, this implies that our present means of observation are sufficient to reveal everything that exists. Realists must either make this assumption, for which they have no warrant, or else reject the recent developments of physics, and leave themselves without any assurance that they can know anything of importance about the external universe. On the other hand, idealists, adopting the view that the universe is constructed mentally by logical inference from experience, see the implication of modern physics as simply the traditional thesis of science that the data chosen shall be pure experience, unalloyed with fancy or arbitrary dogma. A. Hu.

PRESSURE.

***474. Piezoelectric Measurements in Ballistics. H. Illgen.** *Zeits. f. techn. Physik,* 18. 11. *pp.* 470–474, 1937.—The paper discusses the fundamental issues concerned with the methods of measurement and sources of error which are inherent in mechanical means for the estimation of gas-pressures. Apparatus is described for the measurement of gas-pressures in guns, and for the recoil pressures and forces in large and small firearms. The paper compares a piezoelectrically recorded recoil pressure with one obtained from actual recoil movement for the same gun and explosion. Full details are given of the piezoelectric apparatus fitted to an ordinary rifle as also of kinema films showing the records of recoil movement of the rifle after firing, etc. The paper is descriptive of the apparatus used.

S. G. B.

***475. Oil Vapour Trap. P. A. Anderson.** *Rev. Sci. Instruments,* 8. *pp.* 493–495, *Dec.,* 1937.—In vacuum systems using oil vapour pumps it is important to prevent the penetration of the vapour to the evacuated region. This is usually done by means of a trap containing charcoal, but a difficulty occurs in completely degassing the charcoal—it is by no means completely degassed after a week's continuous heating. The new trap is also a charcoal trap, but one in which the charcoal is kept red-hot by means of a heating current. Two designs of trap are described ; one with a shallow bed of charcoal for fast pumping and reasonably good stoppage of oil vapour and the other with a long column of charcoal for slower pumping but thorough stoppage of vapour. Comparative tests against mercury vapour pumps were made in an experiment for the measurement of contact potentials, which are very sensitive to the influence of impurities; no differences were detected under the two conditions of carrying out the experiment. G. G.

See also Abstracts 781, 785, 793.

RELATIVITY AND ETHER.

476. Relativistic Framework for the Causality Principle. W. Scherrer. *Helv. Phys. Acta,* 10. 6. *pp.* 475–489, 1937. *In German.*—Continuing two earlier papers [see Abstract 5226 (1937)] the author attempts to build up a universal point dynamics independently of any special nature of the potential. The analysis has shown that it is above all necessary to compensate for the deficiency of the vector potential. A suitable means for this has proved to be the introduction of the number of the points of action on the orbital lines of the electrons as a function of the length of arc. For this a zero point on the electron path must be chosen for the measurement of length and the counting of the particles. The main results of the investigation are firstly that the dynamics as developed obeys a Hamiltonian principle, and secondly the quantisation of the action yields in the first approximation the Bohr term and in the second approximation the Sommerfeld term, in the case where the potential Φ is replaced by the Coulomb potential. G. O. B.

477. Plane Polarised Waves in the General Theory of Relativity. N. Rosen. *Phys. Zeits. d. Sowjetunion,* 12. 4. *pp.* 366–372, 1937. *In English.*—The system of equations is set up for the gravitational and electromagnetic fields in the general theory of relativity, corresponding to plane polarised waves. It is found that all non-trivial solutions of these equations contain singularities, so that it must be concluded that strictly plane polarised waves of finite amplitude, in contrast to cylindrical waves, cannot exist in the general theory of relativity. AUTHOR.

478. Unified Theory of Gravitation and Electromagnetism. J. Hély. *Comptes Rendus,* 205. *pp.* 1133–1134, *Dec.* 6, 1937.—A certain expression involved in the author's unified field theory having given rise to contradictions with observation, this term is now altered *ad hoc* to secure agreement. G. C. McV.

479. Unitary Non-Holonomous Field Theory. Parts I and II. K. Yano. *Phys. Math., Soc. Japan, Proc.* 19. *pp.* 867–896, *Oct. and pp.* 945–976, *Nov.,* 1937. *In French.*—In Part I various unitary field theories are briefly reviewed and the author develops the unitary non-holonomous field theory proposed by Vranceanu [see Abstract 1062 (1937)]. The theory resembles somewhat those proposed by Kaluza and Klein, Einstein and Mayer, and Veblen and Hoffmann and clarifies the relations between these various theories. In Part II expressions for the geodesics and the trajectories of charged particles in the author's theory are derived and the geometry of the field in general is discussed. The theory is further generalised along lines suggested by Hoffmann (*Quarterly J. of Mathematics,* 7. *pp.* 20–31, 1936). A Bibliography of 74 references is appended. J. S. G. T.

480. Metrical Field and Gravitational Field. J. Weyssenhoff. *Acad. Polonaise Sci. et Lettres, Bull.* 6–8*A*. *pp.* 253–259, *June–Oct,,* 1937. *In German.*—The types and transformations of the normal coordinates of a Riemannian metric in four dimensions are studied under the hypothesis that the coordinates of some particular system transform according to the rules $x'^a = x'^a(x^1, x^2, x^3)$ and $x'^4 = x'^4(x^1, x^2, x^3, x^4)$. G. C. McV.

481. Doppler Effect Considered in Relation to the Michelson-Morley Experiment. H. E. Ives. *J.O.S.A.* **27.** *pp.* **389–392,** *Nov.,* **1937.**—The method of earlier papers is applied to the Doppler effect giving the exponent n the values 1 and 0 [see Abstract 2971 (1937)]. The case of a canal-ray tube viewed end-on is considered. The effect is invariant with motion through the ether only if $n = 0$. It is not null. Observation of it with canal rays should furnish evidence for the validity of the Fitzgerald contraction. H. G. C.

SOLUTION.

482. Activity Coefficients of KCl and $CaCl_2$. E. A. Guggenheim and L. A. Wiseman. *Phil. Mag.* 25. *pp.* 45–48, *Jan.*, 1938.—Formulæ previously given [see Abstract 4289 (1936)] for the mean activity coefficient are applied to the recent experimental data of Schedlovsky and MacInnes for KCl and $CaCl_2$. For KCl the formula fits the experimental results to 1 part in a 1000; for $CaCl_2$ to within about 5 parts in 1000. L. A. W.

483. Solubility of Citric and Tartaric Acids in Water. L. H. Dalman. *Am. Chem. Soc., J.* 59. *pp.* 2547–2549, *Dec.,* 1937.—The solubilities of citric and tartaric acids in water have been determined at 10° intervals (including 25°) over the range of temperature 0–100°. The solubility curve for citric acid consists of two straight line curves which intersect at 35·8°; below this transition temperature citric acid monohydrate exists, while above anhydrous citric acid is the stable phase. The solubility curve for tartaric acid is a straight line representing solutions in equilibrium with the anhydrous form of the acid. AUTHOR.

484. Water Tolerances of Mixtures of Gasoline with Ethyl Alcohol. O. C. Bridgeman and E. W. Aldrich. *Bureau of Standards, J. of Research,* 20. *pp.* 1–8, *Jan.*, 1938.—Equations, based on 23 different gasolines, have been developed for calculating the water tolerance of any mixture of gasoline with ethyl alcohol from critical-solution-temperature measurements on a few mixtures with the particular gasoline. Conversely, it is also possible to compute critical solution temperatures of mixtures of known composition. The average deviation between observed and calculated critical solution temperatures of the 23 gasolines studied was 1·4° C. and the corresponding average difference between observed and calculated water tolerances was 0·005% of the total mixture. [See following Abstract.] AUTHORS.

485. Critical Solution Temperatures of Mixtures of Gasoline, *n*-Propyl Alcohol, and Water. E. W. Aldrich. *Bureau of Standards, J. of Research,* 20. *pp.* 9–16, *Jan.*, 1938.—Data are presented on the separation temperatures of mixtures of 5, 10, 15, 20, and 25% of *n*-propyl alcohol of various water contents with each of three gasolines. These data are compared with similar data on mixtures of gasoline with ethyl alcohol, and it is shown that the water tolerances of mixtures of gasoline with *n*-propyl alcohol are, in general, greater than those of corresponding mixtures with ethyl alcohol. [See preceding Abstract.] AUTHOR.

SURFACE PROPERTIES.

486. Adsorption Isotherms and Heats of Adsorption of Oxygen and Carbon Monoxide on Charcoal. A. van Itterbeek and W. van Dingenen. *Physica,* 4. *pp.* 1169–1180, *Nov.,* 1937. *In English.*—

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Adsorption isotherms are determined for gaseous O_2 and CO on two varieties of charcoal between 90° and 50° K. with temperature intervals of about 5 degrees and for pressures up to 1 mm. The Clapeyron-Clausius formula is applied to calculate the heat of adsorption at various temperatures as a function of pressure. The adsorption isotherms for both gases are of the Freundlich form, $x = ap^{1/n}$, the values of $1/n$ decreasing regularly with decrease in temperature, except that for CO it seems to pass through a maximum at about 61·5° K., a known transformation temperature for solid CO. It is concluded from this result and from the fact that abnormal results are obtained for the heat of adsorption when isothermal data above and below this temperature are inserted in the Clapeyron-Clausius equation, that the adsorbed layer is crystalline and differs in form above and below the transition point. R. W. P.

487. Intermolecular Forces in Two-Dimensional Systems. R. C. L. Bosworth and E. K. Rideal. *Physica*, 4. *pp*. 925–940, *Nov*., 1937. *In English*.—The contribution of potential energy to the spreading force in electropositive gaseous films on solids may be calculated from surface migration experiments, and from Topping's theory. Since good agreement is obtained between the two sets of results, electrostatic interaction accounts for almost all of the surface free energy. This is confirmed when the spreading forces calculated from Topping's expression are compared with those obtained from the Gibbs adsorption isotherm. The difference between the heat of evaporation ϵ and the corresponding activation energy for migration is constant for films for which the Topping expression does not represent the major portion of the interaction between the adatoms, and the significance of this is discussed. The existence of a spreading force indicates that ϵ falls as A decreases, and this is experimentally demonstrated. It is thence deduced that there are large spreading forces in O_2 films. For N_2 films these forces are very much smaller. Spreading forces are at present being investigated with the help of surface mobility by measuring the rate of condensation of a bimolecular gas by means of contact potentials. P. H. B.

488. Surface Areas of Various Adsorbents. S. Brunauer and P. H. Emmett. *Am. Chem. Soc., J.* 59. *pp*. 2682–2689, *Dec*., 1937.—Low temperature van der Waals adsorption isotherms of some or all of the following gases have been determined on a variety of adsorbents at the temperatures indicated: A and N_2 at − 195·8°; A, N_2, CO and O_2 at − 183°; CO_2 at − 78°; normal butane and SO_2 at 0°. The following adsorbents have been used: two copper catalysts, glaucosil, pumice, nickel oxide supported on pumice, nickel on pumice, dry powdered bacteria, chromic oxide gel, "glowed" chromic oxide, potassium chloride, copper sulphate pentahydrate, anhydrous copper sulphate, two silica gel samples, activated charcoal, and two Darco samples (activated carbons). All adsorbents except charcoal gave S-shaped isotherms, and the values for the surface area evaluated from the different isotherms for the same adsorbent were consistent with each other. AUTHORS.

489. Heats of Wetting of Cellulose by Alcohols and their Aqueous Solutions. J. L. Morrison, W. B. Campbell and O. Maass. *Canad. J. of Research*, 15. *Sect.B. pp*. 447–456, *Nov*., 1937.—The heats of wetting of dry cotton cellulose by several pure and aqueous alcohols have been measured for the first time. The rate at which the wetting occurred was also determined. The results indicate a preferential sorption of water from the aqueous alcoholic solutions. This conclusion is supported by similar measurements in experiments in which absolute alcohols were allowed to wet cellulose containing various amounts of previously adsorbed water. AUTHORS.

490. Heat of Sorption of Solvents by Nitrocellulose. Part II. S. Papkov and V. Kargin. *Acta Physicochimica*, 6. 5. *pp*. 667–682, 1937. *In German.*—Previous work [see Abstract 1391 (1936)] is now continued, and the heats of sorption and isotherms are first determined during the sorption of ethyl alcohol and ethyl ether by nitrocellulose. The heats of solution of nitrocellulose in binary mixtures (of ether-alcohol) have also been measured for various compositions. Experimental details are included. It has been established from the experimental data that a competition arises during the solvation between ether and alcohol. From the heat of solution curve the upper limit has been estimated of the energy of the reciprocal effect between the solvating particles themselves. Two possibilities of this reciprocal effect (and structure formation) are considered : (*a*) the existence of a large number of bonds with small energy, (*b*) the existence of a small number of bonds with large energy. The second possibility is regarded as the more probable. On the assumption that every chief valency chain only possesses two bonds (end groups), the reciprocal effect energy has the value of 12–15 kg.cal./mol. H. H. Ho.

491. Surface Tension of Liquid Fluorine and Dielectric Constants of Liquid O_2, F_2, Cl_2 and HCl. E. Kanda. *Chem. Soc. Japan, Bull.* 12. *pp*. 469–479, *Nov.*, 1937.—Using the capillary-tube method, with special modifications owing to the low surface tension and the reactivity of F_2, the surface tension of the liquid was determined over a temperature range from the boiling point to the melting point of liquid F_2, using liquid O_2 as the refrigerating agent. Results, as tabulated and plotted, indicate that liquid F_2 is a normal liquid and that the surface tension is lower than that of liquid O_2. A detailed account of the determination of the dielectric constants of liquid O_2, F_2, Cl_2 and HCl by means of the " beat method " is given. Numerical results are tabulated and plotted. N. M. B.

492. Speed of Spreading of Drops of Aqueous Solutions on Mercury. R. S. Burdon, G. R. Fuller and E. S. H. Gibson. *Faraday Soc., Trans.* 33. *pp*. 1528–1531, *Dec.*, 1937.—Photography shows that, for a given concentration a drop of aqueous solution spreads at nearly uniform speed on Hg. The speed is greater for more concentrated drops, and is accelerated slightly as the drop reaches a diameter of about 3 cm. The spreading is conditioned by the interface, alkaline solutions having a greater interfacial tension against Hg than pure water, while acids, even at extreme dilution, reduce the interfacial tension. [See also Abstract 2410 (1927).] AUTHORS.

493. Spreading with Uniform Acceleration. W. D. Allen, K. Grant and R. S. Burdon. *Faraday Soc., Trans.* 33. *pp*. 1531–1532, *Dec.*, 1937.—The spreading of paraffin on water irradiated with u.v. light or containing traces of fatty acids is discussed. [See also Abstract 2440 (1937) and preceding Abstract.]

494. Contact Angles and Wetting. E. Kneen and W. W. Benton. *J. Phys. Chem.* 41. *pp*. 1195–1203, *Dec.*, 1937.—A simple, adequate horizontal-plate technique for determining contact angles in the system solid-liquid-air is described and its accuracy demonstrated. Applications of this method are illustrated and discussed with reference to (*a*) the evaluation of the wetting capacity of soaps, (*b*) the evaluation of the degree of polarity of surfaces, (*c*) the wetting properties of cholesterol toward water, (*d*) the wetting capacity of leaf surfaces, and (*e*) the wetting properties of tooth surfaces. AUTHORS.

495. Liquid Drops on Liquid Surfaces. T. H. Hazelhurst and H. A. Neville. *J. Phys. Chem.* 41. *pp.* 1205–1214, *Dec.*, 1937.—Drops of certain liquids, falling from a limited height on to a liquid surface, do not merge with the body of the liquid immediately, but may roll or remain at rest upon the surface for a short time. Previous reports on "rolling drops" have considered only drops of the same liquid, and the explanations advanced have involved either (*a*) electrical charges or (*b*) films of adsorbed air or vapour. The present experiments include the formation of drops upon the same and upon different liquids and show that: (1) Most pure liquids will form drops upon themselves. Exceptions are water, formic acid ethylene glycol, and glycerol; (2) One liquid will not form drops upon another unless the two liquids are closely related, *e.g.*, the xylenes; (3) Drop formation is not reciprocal for some liquid pairs; (4) A solution of, for example, ethyl alcohol and benzene will form drops upon the same solution, but neither of the pure components will form drops upon this solution. The results of these experiments indicate that current explanations of this phenomenon are inadequate, and suggest that the character and stability of the oriented surface film is the determining factor. Long-chain molecules with polar groups located near the centre are the "best" drop formers. A table of critical heights for a variety of liquids is presented. AUTHORS.

496. Flow of Monomolecular Films. M. Joly. *J. de Physique et le Radium*, 8. *pp.* 471–476, *Nov.*, 1937.—The "viscosities" of surface films are measured by a capillary flow method in which the capillary consists of a long narrow channel situated in the surface. Films are shown to possess viscosities characteristic of their composition and state. Investigation of films by this method gives results in good agreement with those obtained by other methods. The triglycerides form the subject of special investigation. P. H. B.

497. Copper Oxide Films. H. A. Miley. *Am. Chem. Soc., J.* 59. *pp.* 2626–2629, *Dec.*, 1937.—The thicknesses of oxide films produced on heated Cu have been estimated by measuring the number of millicoulombs needed for their kathodic reduction. The relations between film thickness and time of heating indicate that the parabolic law $y^2 = kt + A$ is only valid for short periods and that A is not zero for abraded surfaces. The colour film on tinted Cu may contain CuO as well as Cu_2O—apparently in intimate admixture—but under strongly oxidising conditions, a separate sooty film (presumably CuO) obscures the later colours. AUTHOR.

498. Cohesive Forces of Liquids. A. T. van Urk. *Physica*, 4. *pp.* 1025–1033, *Nov.*, 1937. *In English.*—From both experimental and theoretical evidence it is shown that the so-called Stefan relation, which postulates that the work required to remove a molecule from within a liquid to the surface is equal to half the heat of vaporisation, is untrue. Only for H_2 is the experimental ratio as great as 0·4, for N_2, A, O_2, Ne and CO it lies within 8% of 0·26 and is still smaller for more complex molecules such as CO_2, CCl_4 and C_6H_6. Several theoretical derivations follow based on various assumptions, and in each case the ratio is of the order of 0·28. R. W. P.

499. Atomic Forces of the Solid State. Part VII. Weng Wen-Po. *Phil. Mag.* 25. *pp.* 111–129, *Jan.*, 1938.—This paper is a direct continuation of previous work [see Abstract 4328 (1937)], in which some refinements of the former treatments of atomic volume and anharmonic motion are now presented and followed by new developments with respect to latent heat of vaporisation and fusion. The formula of surface tension and the characteristic frequency for metals have been tested for some more elements with less definite data, *e.g.*, Ag, Cr, Na, Pt, Sb. The paper is replete with numerical data. H. H. Ho.

***500. Lubrication of Taps with Phosphoric Acids. D. L. Chapman and L. A. Moignard.** *Chem. Soc., J. pp.* 1936–1938, *Dec.*, 1937.—A new tap is described in which phosphoric acid is used as lubricant. Details are given for the preparation of the latter and for using the tap. AUTHORS.

See also Abstracts 405, 406, 411, 859, 875 and 350B. Electrolytic Polishing of Aluminium. P. Jacquet.

TIME.

***501. Electronic Circuits for Measurement of Time and Speed. H. J. Reich and H. Toomim.** *Rev. Sci. Instruments*, 8. *pp.* 502–504, *Dec.*, 1937.—Describes a valve circuit for measuring time intervals, controlled by switches or photo-cells, and one for the measurement of speed. Suitable values for the component resistances and capacities are given, and details of calibration. The circuits have been used successfully in the measurement of time of reaction to a stimulus (such as a red traffic light), the speed of a projectile, and the acceleration due to gravity. J. S. C.

VISCOSITY AND FRICTION.

502. Effect of Magnetic Field on Viscosity of Gases. H. Senftleben and H. Gladisch. *Ann. d. Physik*, 30. 8. *pp.* 713–727, *Dec.*, 1937. *Zeits. f. techn. Physik*, 18. 12. *pp.* 580–582, 1937. *Phys. Zeits.* 38. *pp.* 1006–1008, *Dec.* 1, 1937.—It has been shown that the thermal conductivity of paramagnetic gases is diminished by a magnetic field [see Abstract 4769 (1936)]. The present paper describes measurements by a delicate method, of the relative change of viscosity $-\Delta\eta/\eta$ in the gases O_2 and NO in fields up to 6000 gauss. The value of $-\Delta\eta/\eta$ increases with the field H, but diminishes as the pressure p increases. Within wide limits of H/p, the ratio of the relative change in thermal conductivity to the relative change in viscosity is constant. G. E. A.

503. Solid Friction. J. Mercier and J. Dubois. *Comptes Rendus*, 205. *pp.* 964–966, *Nov.* 22, 1937.—As a result of preliminary studies of kinetic friction (K) it is concluded that the K/pressure (p) and K/velocity (v) curves are more regular as p and v are higher. As v increases from zero K diminishes to a minimum for v = a few tenths of 1mm./sec., and then usually increases to a maximum. Hardness has a great effect, the average value of K decreasing as hardness increases. Similarly polishing reduces K and increases the regularity of the curves. C. A. S.

504. Internal Friction in Solids. Part II. General Theory of Thermoelastic Internal Friction. C. Zener. *Phys. Rev.* 53. *pp.* 90–99, *Jan.* 1, 1938.—Stress inhomogeneities in a vibrating body give rise to fluctuations in temperature, and hence to local heat currents. These heat currents increase the entropy of the vibrating solid, and hence are a source of internal friction. The general theory of this internal friction is here developed. The simplest example of stress inhomogeneity is that occurring in the transverse vibrations of reeds and wires. Explicit formulæ are obtained for reeds and wires, and the effect is calculated of crystal orientation in single crystal specimens. Microscopic stress inhomogeneities arise from imperfections, such as cavities, and from the elastic anisotropy of the individual crystallites. The internal friction due to spherical cavities is calculated. The internal friction due to elastic anisotropy is investigated for cubic metals, and is found to be greatest for Pb, least for Al and W. [For Part I see Abstract 3934 (1937).] AUTHOR.

505. Internal Friction in Solids. Part III. Experimental Demonstration of Thermoelastic Internal Friction. C. Zener, W. Otis and R. Nuckolls. *Phys. Rev.* 53. *pp.* 100–101, *Jan.* 1, 1938.—In order to demonstrate the presence of thermoelastic internal friction, the internal friction of a copper reed over a wide frequency range (50 to 4000 cycles/sec.) was measured. They obtained a maximum precisely at the predicted frequency. The observed variation of internal friction with frequency proves that, over a wide frequency range, the internal friction due to the flow of heat back and forth against a reed is of a larger order of magnitude than that due to all other causes. Independent experiments of Bennewitz and Rötger on wires of Ag, Al, brass, steel, and glass are shown to furnish an equally striking demonstration of thermoelastic internal friction. [See preceding Abstract.] AUTHORS.

See also Abstracts 455, 551.

ASTRONOMY AND ASTROPHYSICS.

ASTRONOMICAL APPARATUS AND OBSERVATORY EQUIPMENT.

***506. Northumberland Telescope at Cambridge Observatory. F. J. Hargreaves.** *Observatory*, 60. *pp.* 322–326, *Dec.*, 1937.—The 11¾-inch object-glass was made by Cauchoix over 100 years ago, from glass supplied by Guinand (Fraunhofer's instructor in glass-making), and for some time was the largest object-glass in existence. With it Neptune might have been, but was not, discovered. Its spherical aberration was very great, and it has been tested by the author, using the auto-collimation method with artificial stars consisting of very small mercury globules illuminated and adhering to black velvet. The glass was badly striated, yet the image in monochromatic light was quite circular, the striæ doing nothing more than to scatter light over the field. Foucault's knife-edge test was used for the spherical aberration, and the surface tested proved to be an exact surface of revolution and very nearly spherical. It was then refigured, the radius of curvature of the central part being shortened, until it was about 3·5 mm. shorter than the marginal radius, and the correct Airy disc and rings appeared. It is now a prolate ellipsoid. The chromatic aberration was not changed appreciably. The margin of the surface was rather turned down, but this zone finally merged smoothly into the ellipsoidal curvature. The cell has 6 spindles provided with Hooke's joints, evidently for attachment to control rods extending to the eye-end, for squaring-on and other movements while looking into the eyepiece. A similar device was independently employed by the author some years ago. M. A. E.

*507. **Building the 200-inch Telescope. C. S. McDowell.** *Frank. Inst., J.* 224. *pp.* 675–695, *Dec.*, 1937.—The supervising engineer describes the work being done on Mt. Palomar for housing and mounting this instrument. The governing principle throughout is to permit, at every available minute of good seeing, full use of its light-gathering power, four times that of any other instrument. Many recently invented materials and technique are made use of, including super-pyrex glass with aluminium coating for the mirror, alloys with the same low coefficient of expansion for its supports, accurate remote-control mechanism for movements in R.A. and Dec. similar to that now used for elevators and canal locks, a crystal-controlled sidereal clock. An apparatus is also being devised by which a star in the telescopic field can with its light hold the telescope on the object to be observed. All mechanisms are first tested on models or smaller instruments. It is thought that this is the largest mirror it will ever be desirable to make: it weighs 33,000 lbs., and will be carried on 36 counter-balanced supports, the rib structure on the back giving the maximum stiffness with minimum weight. Detailed descriptions of the telescope tube and declination axis, the dome and foundations, are accompanied by numerous diagrams and photographs. The water supply, power plant, machine shop for repairs, accommodation for staff, and road from the valley below, are all complete. M. A. E.

*508. **Slit Spectrograph for Diffuse Galactic Nebulae. O. Struve.** *Astrophys. J.* 86. *pp.* 613–619, *Dec.*, 1937.—A spectrograph has been constructed which consists of a wide slit, attached to the outside of the upper end of the tube of the 40-in. telescope, and an f : 1 Schmidt camera of 94 mm. aperture with two 60° quartz prisms. Very faint nebulæ can be observed with this instrument, provided their diameters exceed 11′. AUTHOR.

COMETS AND METEORS.

509. **Observations of Comets 1937 b, c, and *f*. W. H. Steavenson.** *Roy. Astron., Soc. M.N.* 98. *pp.* 75–77, *Nov.*, 1937.

COSMOGONY.

510. **Kinematical Theory and the Distribution of Nebulæ. G. C. McVittie.** *Zeits. f. Astrophysik*, 13. 5. *pp.* 312–320, 1937. *In English.*—It is shown that in order to bring Milne's kinematical theory of the universe into agreement with Hubble's nebular counts, curved space-time must be introduced into the theory. This suggests that Milne's principle of the "absence of dimensional constants" in his theory of gravitation requires modification. AUTHOR.

See also Abstract 473.

DYNAMICAL PROBLEMS (ASTRONOMICAL).

511. **Statistically Steady Distributions in Astronomy. H. Jeffreys.** *Roy. Astron. Soc., M.N.* 98. *pp.* 59–64, *Nov.*, 1937.—A critical discussion is given of the theorem concerning the distribution-function of a set of moving particles in a general field of force but excluding the effect of close encounters, *viz.*, that for steady motion the distribution-function does not depend on the time but only on the positions and velocities. The interpretation of this theorem on the basis of probability is rejected and the effect of sampling errors on its validity is pointed out. The types of

astronomical problem to which the theorem may or may not be applied are discussed. G. C. McV.

512. Motion of Nodes and Apsides in Planetary Systems. H. Fabre. *Comptes Rendus*, 205. *pp.* 1042–1044, *Nov.* 29, 1937.—The movement of the line of apsides of a perturbed planetary orbit is determinable precisely only when the eccentricity and the inclination of the orbit are small. A method is developed for the determination of secular perturbations whatever the inclination of the orbit. An expression is obtained for the retrograde nodal motion on the plane of the equator, and a function defined which determines the direction of motion of periastron and its mean angular velocity. For stable motions in axially-symmetrical fields of force, the longitudes ω of node and periastron respectively are given by formulæ of the type $\omega_n = -\alpha t +$ quasi-periodic function of t ($\alpha = \text{const.} > 0$), $\omega_p = \beta t +$ quasi-periodic function of t ($\beta = \text{const.}$), each quasi-periodic function having two fundamental frequencies. Analogous formulæ with 3 frequencies show that the retrograde motion of the nodes is not constant and that in certain conditions of inclination and eccentricity the motion of the line of apsides is a libration. A. Hu.

513. Absolute Orbits of Planets. H. Fabre. *Comptes Rendus*, 205. *pp.* 1214–1216, *Dec.* 13, 1937.—In Gyldén's " absolute orbits " the initial conditions are chosen so as to simplify the calculations, but in such a way that the departure of the absolute orbit from the corresponding actual orbit is arbitrarily small during a time arbitrarily long. Gyldén attempted to represent planetary coordinates by generalised Fourier series of absolute and uniform convergence, the independent variable being Hansen's longitude or the time. Unfortunately these series are not necessarily convergent. The author nevertheless retains the idea of absolute orbits as being too useful to reject, and puts it on a narrower but more rigid mathematical basis. A. Hu.

See also Abstract 528.

NEBULÆ.

514. Photographic Studies of Nebulæ. J. C. Duncan. *Mt. Wilson Observat. Contrib. No.* 579. *Astrophys. J.* 86. *pp.* 496–498, *Dec.*, 1937.—Photographs of nebulæ, diffuse and planetary, are reproduced. The dark nebulæ Barnard 92 and 93 Sagittarii, photographed with the 100-in. telescope, show no change in an interval of 14 years. 17 bright planetary nebulæ were photographed with both short and long exposures. Faint envelopes surrounding the Ring nebula in Lyra and NGC 6826 Cygni are displayed. Four other planetary nebulæ exhibit various interesting features. [See also Abstracts 1343 (1923) and 1777 (1926).] AUTHOR.

515. Variation of Light from Night Sky and its Effect on Photography of Faint Nebulæ. C. T. Elvey and P. Rudnick. *Astrophys. J.* 86. *pp.* 562–569, *Dec.*, 1937.—Observations made with a photoelectric photometer using a potassium photoelectric cell show irregular variations, through the night, in the intensity of the light from the sky in the region of the North Pole. There are also variations from night to night, which are quite large. Computations have been made of the limiting magnitude of nebulæ which could be observed, taking into consideration the variation of the sky brightness with respect to zenith distance, the zodiacal light, and the Milky Way. It is concluded that the limiting magnitude of a nebula is a function of the position with respect to the zenith, the zodiacal light, and the Milky Way, and also with respect to time. For precise photometry of faint nebulæ it is necessary to determine the brightness of the sky background by calibration with stars in the field at the time the photograph is being made. AUTHORS.

516. Colour Indices of Reflection Nebulæ. O. C. Collins. *Astrophys. J.* 86. *pp.* 529–561, *Dec.*, 1937.—Colour indices for 18 reflection nebulæ have been determined. Two methods were used, both of which employ corrections for the removal of the superimposed sky brightness from the nebular image and comparison of the nebula with the surrounding sky. In the first method a mean colour index of + 0·5 mag. is adopted for the sky. In the second, which gives results with much less scatter, the surface brightness of sky and nebula in blue and in red light is calculated by the use of extrafocal images of the stars which illuminate the nebulæ. Corrections are made for differences in length of focal and extrafocal exposures. Time effects in sensitometry are discussed. All results are reduced to the Mount Wilson system, and use is made of the known colour excesses of the illuminating stars. The sky brightness is found to vary with time and with altitude, particularly on the red exposures. The nebulæ are found to be, in general, bluer than their illuminating stars. The difference of colour ranges from − 0·5 mag. to 0·0 mag., the mean being − 0·3 mag. There is an indication that the colour excesses of the nebulæ are correlated with the colour excesses of the stars. The observed facts are consistent with the hypothesis that the star's light is made uniformly bluer by reflection, by about 0·5 mag., and that passage through the nebula superimposes a change of colour toward the red in proportion to the colour excess shown by the star. AUTHOR.

See also Abstracts 508, 510.

PLANETS.

517. Reference Stars for the Opposition of Eros, 1931. H. Spencer Jones and P. J. Melotte. *Roy. Astron. Soc., Mem.* 65. 4. *pp.* 87–154, 1937.

518. Observations of Eros at the 1931 Opposition with a Preliminary Determination of the Solar Parallax. R. J. Trumpler, F. J. Neubauer, P. H. Hutchings, C. E. Smith and K. P. Kaster. *Lick Observat., Bull. No.* 490. *pp.* 93–107, 1937.—Two series of observations were taken at Lick; this concerns the second series which were made with a wide angle camera of 5 in. aperture and 15 ft. focus. Five tables are given of which the first four deal with the reference stars, and their residuals, the plate constants and positions of Eros. The fifth gives a derivation of the solar parallax; the result from the R.A. measures being, $\pi = 8''\cdot785 \pm 0''\cdot008$. A. S. D. M.

See also Abstracts 512, 513, 571.

STARS.

519. Stellar Luminosity and Boundary-Layer Opacity. E. A. Milne. *Roy. Astron. Soc., M.N.* 98. *pp.* 21–41, *Nov.*, 1937.—The author extends his method of determining photospheric pressure, using the conception of continuity of gas-pressure [see Abstract 3449 (1937)], to levels lying far underneath the photosphere, yet sufficiently far from the centre to be counted in the boundary layers. He analyses the equilibrium of these layers and traces their fit with the deeper interior. They are shown to be divisible into 3 zones, of which the third, Zone C, is the effective boundary from the point of view of the equilibrium of the interior. By equating the gas pressures found by working from outside and from inside towards Zone C, a luminosity formula is developed involving the internal density-distribution. From this it is concluded that the inferences usually made as to the gaseous character of the interior and its H content really apply only to Zone C. The analysis is extended to cover a generalised law of exterior opacity, and a more rigorous luminosity relation is deduced. A. Hu.

520. New Methods in Stellar Statistics. A. Brill. *Preuss. Akad. Wiss. Berlin, Abhandlungen, No.* 2. [24 *pp.*], 1937.—In the photometry of stars the author has introduced the concept of the " isophoton " wave-length. By analogy a certain type of absolute magnitude is now defined and it is shown in detail how this absolute magnitude may be used to find the spatial distribution of stars. In particular the spatial distribution of the stars of different spectral types in galactic latitude + 50° is given, as well as the distribution of stars of all spectral types. G. C. McV.

521. Stellar Parallaxes Determined at the Royal Observatory, Greenwich. *Roy. Astron. Soc., M.N.* 98. *pp.* 78–80, *Nov.*, 1937.—A continuation of the relative parallaxes obtained with the 26-in. refractor [see Abstract 561 (1937)].

522. Stellar Parallaxes Determined Photographically at the Royal Observatory, Cape of Good Hope (Ninth List). *Roy. Astron. Soc., M.N.* 98. *pp.* 81–87, *Nov.*, 1937.—The form of publication is similar to that of previous lists [see Abstract 560 (1937)].

523. Continuous Hydrogen Absorption of cA Stars. Y. Öhman. *Arkiv. f. Mat. Astron. och Fysik, Stockholm,* 25*B. No.* 20. [6 *pp.*], 1937. *In English.*—The present work confirms earlier results concerning the strong continuous hydrogen absorption in cA stars [see Abstract 3795 (1935)]. In stars with Hα bright a less pronounced continuous absorption has been found which indicates an overlapping continuous emission. But also in these cA stars the discrepancy between the faint line absorption and the marked continuous absorption is a characteristic feature which can be used as a luminosity criterion. AUTHOR.

524. New Solutions of the Equation of Radiative Transfer. L. Spitzer, Jr. *Astrophys. J.* 87. *pp.* 1–8, *Jan.*, 1938.—Solutions of the equation of radiative transfer are given for two assumed variations of η_ν with optical depth, valid for η_ν increasing or decreasing with τ. The first appears as a generalisation of the Eddington solution. The second avoids the negative absorption inherent in previous investigations and leads to a simple formula convenient for numerical applications. For certain values of the constants the formulæ are expressible in terms of simple powers and exponents. [See also Abstract 3453 (1937).] AUTHOR.

525. Unidentified Interstellar Lines in the Yellow and Red. P. W. Merrill and O. C. Wilson. *Mt. Wilson Observat., Contrib. No.* 582. *Astrophys. J.* 87. *pp.* 9–23, *Jan.*, 1938.—Six unidentified interstellar lines are discussed. Following a brief history of previous observations, widths and central absorptions of three of the lines are given. The total intensity of λ 6284, which, in the mean, equals the average for the detached lines D1 and D2, shows a somewhat stronger correlation with stellar colour excess than does the intensity of the D lines. The widths of the unidentified lines, which are rather diffuse and not sharp like the D lines, and other facts make an atomic origin improbable. The lines may be portions of molecular bands, as yet unidentified. Several facts, however, suggest that the lines are produced by small solid particles, perhaps closely related to those that cause space reddening. AUTHOR.

526. Line Intensities in U.V. Stellar Spectra. L. H. Aller and L. G. Stoddard. *Astrophys. J.* 87. *pp.* 53–67, *Jan.*, 1938.—Eye-estimates of intensity, on an arbitrary scale, of 17 u.v. lines of neutral Fe, Mg and Al have been made on 66 plates distributed among 31 representative supergiants, giants, and dwarfs. These intensities are compared with half-breadths computed on the basis of Pannekoek's recent theory, and the results are discussed. AUTHORS.

527. Excitation of Emission Lines in Extended Chromospheres by Electron Impact. K. Wurm. *Zeits. f. Astrophysik*, 13. 5. *pp.* 321–340, 1937.—The theory that the forbidden lines in the spectra of planetary nebulæ are excited by electron impact suggests that low-level forbidden transitions may occur whenever high-level normal transitions are lacking. This in turn raises the question whether emission lines corresponding to forbidden and allowed deep transitions may not be caused in general by electron impact. The author investigates the relative intensities of forbidden and allowed lines to be expected when the excitation is by this means. It is shown that at gradually decreasing pressures the population in metastable levels should increase relative to that in normal levels. In other words, at low pressures the electron velocities are such that there is little difference of excitation probability between normal and metastable terms. Thus the intensities of lines with weak and strong transition probabilities tend to balance more and more nearly. The pressure at which the balance is exact depends on the lifetime of particles in the metastable level concerned. A. Hu.

528. Equilibrium of Stellar Clusters. H. Mineur. *Comptes Rendus*, 205. *pp.* 1213–1214, *Dec.* 13, 1937.—In a previous paper [see Abstract 3458 (1937)], the author introduced into the expression for the gravitational potential of the galaxy a term in ξ^2 taking account of the differential rotation of the universe. This term is now neglected, but a term in ζ^2 introduced. It is shown that the mean density of a cluster is related to the amount of flattening it exhibits. The characteristics of a cluster are thus expressible in terms of its flattening and the number of stars it contains. A cluster of some 100 stars with an eccentricity of 0·6 to 0·95, should have a radius of 2·5 parsecs, a result in agreement both with observation and with the earlier paper. In such a cluster the dispersion of velocities is about 0·2 km./sec. A. Hu.

529. Objective Prism Observations of Nova Lacertæ (1936). D. L. Edwards and D. R. Barber. *Roy. Astron. Soc., M.N.* 98. *pp.* 42–52, *Nov.*, 1937.—A description is given of the principal changes in the spectrum of Nova Lacertæ (1936) as observed with the 12-inch prismatic camera of the Norman Lockyer Observatory. The changes run through what is usually regarded as a normal course for such stars, commencing with a widened and displaced α Cygni absorption spectrum, followed by various stages of mixed absorption and emission, and ending with a purely emission spectrum of nebular type. Tables are given of the more prominent absorption and emission lines, with an indication of their characters, widths and dates of appearance. Approximate values of radial velocities were obtained by using the known wave-lengths of interstellar lines, tables being given to illustrate the results. Some of the absorption lines show very high velocities on later dates, while the emission lines show a progression from positive to negative values. AUTHORS.

530. Variables in Kapteyn's Selected Areas 2–19. E. A. Baker. *Roy. Astron. Soc., M.N.* 98. *pp.* 65–74, *Nov.*, 1937.—A continuation of previous work [see Abstract 3460 (1937)].

531. Spectrophotometric Study of Algol Minima. Tcheng Mao-Lin. *Comptes Rendus*, 205. *pp.* 1217–1219, *Dec.* 13, 1937.—About 1908 Nordmann and Tikhov found that minima for blue rays came later than for red rays in the cases of Algol and λ Tauri, and of RT Persei and W Ursæ-Majoris respectively; in the case of Algol the values differed much from one observer to another. Lately Hellerich (from recent photometric measures) found nothing of this sort in the minima of U Cephei and R Z Cassiopeiæ. The author has observed 4 Algol minima (16th Aug., 1936, 7th and 10th Sept. and 12th Nov., 1937) and finds no appreciable differences between the minima epochs and other radiations for the interval 3900–6500 Å. He gives a diagram for 7th Sept., 1937. A. S. D. M.

532. Contours of Hγ and Hδ in δ Cephei. C. J. Krieger. *Astrophys. J.* 86. *pp.* 489–495, *Dec.*, 1937.—The contours Hγ and Hδ were measured on 25 spectrograms and were found to vary within wide limits throughout the period. The half-widths are greatest shortly before maximum light and smallest near minimum light. With an adopted value of log *g* the temperature variation of the atmosphere is determined from Verweij's tables on the Stark effect. Different temperatures result from half-widths taken at different residual intensities. This discrepancy is attributed to the fact that the variation of the temperature with the depth in the atmosphere was neglected. At residual intensity 0·9 the temperature variation is about 5800°–7100° K., as compared with 5100°–6600°, the average by seven other methods. [See also Abstract 2468 (1937).] AUTHOR.

533. Excitation of Emission Lines in Late-Type Variables. A. D. Thackeray. *Mt. Wilson Observat., Contrib. No.* 580. *Astrophys. J.* 86. *pp.* 499–508, *Dec.*, 1937.—Twelve bright lines observed in Me variables are attributed to resonance excitation, chiefly by u.v. lines. In particular, MgII 2795 and 2802 will account for Fe 4202, 4308, 3852, and Ti 4372. The appearance of a bright line λ 3907 is attributed to excitation by a bright K line at low levels which is masked by an upper layer of absorption. Five other lines are attributed to intercombination lines of Fe II. The MgII lines can be readily excited by chemiluminescence in the formation of H_2, the most abundant molecule. AUTHOR.

534. Infra-Red Stellar Surveys and Index Sequences. C. Hetzler. *Astrophys. J.* 86. *pp.* 509–528, *Dec.*, 1937.—A discussion of spectral radiation and photometry is followed by the development of the use of the outstanding infra-red indices of long-period variables and " infra-red stars " as a method for the detection and classification of these objects. The reddest stars in eight fields of 50 sq. deg. have been catalogued and charted. No infra-red indices (visual to 8500 Å) have been found greater than about 9 or 10 mag., which seems to be a critical limit, since a considerable fraction of the sky—about 3000 sq. deg.—has been covered to the eighth magnitude (for A0 Stars). New red variables are among the stars listed, most of which are probably giants. No proper motions have been noted for the brighter ones by superposition of the plates. Four intrinsically faint (visually) proper-motion stars, Wolf 359, M_v 16·5; o^2 Eridani C, M_v 12·3; Barnard's star, M_v 13·7; and CC 1382,

M_v 11·8, have been found to have infra-red indices of 5, 2·8, 3·0 and 2·5 mag., respectively. With one possible exception, no infra-red Algol stars have been found on a number of survey plates examined for this purpose. Attention is called to certain other stars which may be suspected of duplicity, there being possible infra-red companions. [See also Abstract 2610 (1936).] AUTHOR.

535. Interpretation of Epsilon Aurigæ. G. P. Kuiper, O. Struve and B. Strömgen. *Astrophys. J.* 86. *pp.* 570–612, *Dec.*, 1937.—The light-curve of this star is re-discussed with the help of spectrographic elements determined at Yerkes Observatory, and its character as an eclipsing binary with a period of about 27 years is confirmed. The inclination of the orbit, however, cannot be greater than 70°, and the eclipse is not central but grazing. The small bright component is an F2 star; the larger and more massive is infra-red, with a temperature of only 1200°–1400°, and it gives no appreciable light in the region covered by the spectroscopic observations. The earlier hypothesis that this dark occulting star is semi-transparent removes some, but not all, difficulties in explaining its physical condition. It is now suggested that a semi-opaque shell of absorbing material surrounds it, and that this is formed by photoelectric ionisation by the F2 star's radiation. Throughout eclipse the light observed is due to the F2 star, although one-half is absorbed at minimum by its passage through the outer shell of the infra-red star. Lines due to this shell are also present; their intensities and displacements accord with the new hypothesis, and an equatorial velocity of rotation of about 50 km./sec. is indicated. Some features of the eclipse recall those of the expanding shells of Novæ and P Cygni stars. M. A. E.

536. Comparison between the Right Ascensions of the Second Greenwich Catalogue of Stars for 1925·0 and of the FK$_3$. W. M. H. Greaves. *Roy. Astron. Soc., M.N.* 98. *pp.* 53–58, *Nov.*, 1937.—The systematic differences in right ascension between the Second Greenwich Catalogue for 1925·0 and the FK$_3$ (*Dritter Fundamentalkatalog des Berliner Astronomischen Jahrbuch*) have been determined. The $\Delta\alpha_a$ values include periodic terms corresponding to an annual error, with a total range of 0″·4, in the determination of azimuth. A similar effect, but of opposite phase, is present in the previous Greenwich Catalogue, and the change between the two catalogues appears to be associated with a change in the system of determining azimuth, whereby the list of azimuth stars was extended from the neighbourhood of the pole to south of the zenith. AUTHOR.

See also Abstracts 517, 537, 631.

SUN.

537. Relative *f*-Values for Lines of Fe I and Ti I. R. B. King and A. S. King. *Mt. Wilson Observat., Contrib. No.* 581. *Astrophys. J.* 87. *pp.* 24–39, *Jan.*, 1938.—The relative *f*-values for 115 lines in 19 multiplets of Fe I between λ 2912 and λ 5455 and for 227 lines in 66 multiplets of Ti I between λ 3123 and λ 6743 have been derived from measurements on electric-furnace absorption spectrograms. The method is essentially the same as that previously described [see Abstract 535 (1936)] which gave results for 75 lines in 9 multiplets of Fe I. All the lines arise from the lowest terms in the atoms, ranging in excitation potential from 0·0 to 1·5 volts for Fe I and from 0·0 to 2·5 volts for Ti I. [See following Abstract.] AUTHORS.

538. Temperature in the Solar Reversing Layer Derived from Titanium Lines. R. B. King. *Astrophys. J.* 87. *pp.* 40–44, *Jan.*, 1938.—A temperature for the solar reversing layer is derived by a comparison of the equivalent widths of solar Ti I lines with laboratory *gf*-values. Boltzmann factors for lines arising from different low-energy levels are found by plotting solar equivalent widths as a function of *gf*. These give a mean temperature of 4400° K. An empirical curve of growth for the sun is constructed with the aid of the temperature thus found and the laboratory *gf*-values for Fe I and Ti I. [See preceding Abstract.] AUTHOR.

539. Effect of an Adiabatic Layer upon Solar Limb Darkening. P. C. Keenan. *Astrophys. J.* 87. *pp.* 45–52, *Jan.*, 1938.—On the assumption that there exists a zone of instability characterised by an adiabatic temperature gradient beginning at optical depth τ_1 below the surface of the photosphere, the boundary conditions determine the distribution of temperature within the unstable layer. The limb darkening can then be determined for different values of τ_1 and computations carried out for boundaries of 1·0, 0·67, 0·50, and 0·28 predict curves of darkening similar in character to the observed curve. However, an appreciable effect due to the adiabatic layer could occur only if its upper boundary were considerably higher than the optical depth of two now generally assigned to it. AUTHOR.

540. Contours of Lines at the Extreme Limb of the Sun. R. v. d. R. Woolley. *Roy. Astron. Soc., M.N.* 98. *pp.* 3–20, *Nov.*, 1937.—Theoretical contours of lines changing over from absorption to emission at the extreme limb are calculated from a strict application of the models η constant and $(1 + \eta)^{-1} = a + \beta\tau$, and also from equations intended to represent fluorescence in an approximate way. It is suggested that further eclipse observations of spectra at the extreme limb will throw light on the theory of the formation of lines: in particular the chromospheric emission lines should show reversed contours if there is no fluorescence or any other failure of simple theory. The contours for chromospheric lines show that part of the discrepancy between the observed emission gradient of the chromosphere and the density gradient given by gravitational equilibrium may be attributable to self-absorption. In the concluding section it is shown that anomalous dispersion can have on appreciable effect in the chromosphere. AUTHOR.

541. Fundamental Arc Series in Sodium and its Presence in the Sun. P. Rood and R. A. Sawyer. *Astrophys. J.* 87. *pp.* 68–71, *Jan.*, 1938.—Using a powerful discharge tube of new design, the infra-red arc spectrum of Na has been photographed, and measured with a thermopile, as far as λ 12679, $3^2D–5^2F^\circ$. In addition to this line, five members of the $^2D^2F^\circ$ series in Na I were measured with an accuracy of ± 0·2 or ± 0·3 astronomical units. Data supplied by C. E. Moore and H. D. Babcock, of the Mount Wilson Observatory, indicate that this Na series is present in the solar spectrum. New values for the $^2F^\circ$ terms are given. In addition, three members of the $4^2S–5^2P^\circ$ series were observed for the first time. AUTHORS.

542. Age of the Sun, Disintegration Constant of Ac U and the Mass Proportions Pb to Th to U on the Earth. S. Meyer. *Akad. Wiss. Wien, Ber.* 146. 2a. 3–4. *pp.* 175–197, 1937.—From the view that the proportion of Pb to U on the earth is the same as in the sun and farther that besides the various kinds of Pb formed from radioactive disintegration Pb otherwise produced exists only in a negligible degree, as was shown to be quite possible, it follows: For those epochs in which the sun already approximated to that condition in which it is at present known its age can be determined. There is found from the connecting of the data for the proportion of the mixed leads found on the earth to U. and from the relative frequency of the various Pb isotopes in normal Pb a scale of age. Thence the possible half-value times of Ac U and its mass proportion to U related to the Pb/U proportions are deduced and indicated in curves. The half-value time of Ac U amounts to $7 \pm 0{\cdot}5 \times 10^8$ years. The age of the sun is $4{\cdot}6 \pm 0{\cdot}4 \times 10^9$ years. J. J. S.

543. Position Measurements of Granules on the Sun. P. ten Bruggencate and W. Grotrian. *Zeits. f. Astrophysik*, 13. 5. *pp.* 341–347, 1937.—In some photographs taken on June 25, 1905, Hansky noted a number of granules near a small sunspot: he believed he could identify several of these on successive plates, and could trace changes of position. From his measures he concluded that they were moving on the sun's surface with a mean velocity of 3 to 5 km./sec. Chevalier, however, also tried in 1912 to see and measure lateral movements, but concluded that all the changes observed could be otherwise explained. Hansky's measures are here discussed. Rapid changes in form and brightness of granules make such measures very difficult, and his results are shown to have been probably due to errors of measurement, or possibly to a phenomenon resembling scintillation in stars. M. A. E.

544. Apparent Enlargement of the Sun at Rising and Setting. V. Cornish. *Nature*, 140. *pp.* 1082–1083, *Dec.* 25, 1937.—The effect is commonly ascribed to a mental comparison of the sun's angular diameter with the estimated linear dimensions of objects on the horizon. Measurements on sketches made for other purposes by the author during the last 40 years do not confirm this explanation. The apparent size of the rising sun is measured on various sketches with the horizon at eye level and at an elevation of 20°. The sun appears small on the latter, as it would at this elevation above an eye-level horizon. Measurements of the arc of the horizon comprised in the different sketches suggest that the field of attention varies according to circumstances, and the mind transfers the change of magnitude to the objects in the field, but in the reversed sense, an actual restriction of the field being accompanied by apparent enlargement of the objects viewed. A. Hu.

See also Abstract 582.

ZODIACAL LIGHT AND GEGENSCHEIN.

See Abstract 515.

GEOPHYSICS.

GEODESY.

***545. Pendulum Oscillations under the Influence of Tidal and Atmospheric Forces. H. Lettau.** *Gerlands Beitr. z. Geophys.* 51. 2–3. *pp.* 250–269, 1937.—The principles of construction of a new type of horizontal double pendulum are given. From registrations obtained during two months at Leipzig, with a sensitivity of 0·0009″/mm. the mean solar and lunar tidal variations have been detected by harmonic analysis. The amplitude is a complex phenomenon caused by gravitational and atmospheric forces. A number derived for the influence of pressure gives a value for the rigidity of the continental shelf according to Darwin's theory but it is about one-tenth of that usually accepted. Without using Darwin's theory this pressure coefficient can explain Schweydar's S_2-wave of the tidal motions of the plumb line observed in Freiberg. Also Steinhauser's calculations of the deformation of the earth's crust caused by the varying load of snow in the Alps during winter have been compared with the influence of pressure variations of the earth's crust. R. S. R.

HYDROSPHERE, PHYSICS OF THE.

546. Energy of the Secondary Undulations of Oceanic Tides in a Bay. M. Nakano. *Geophys. Mag., Tokyo,* 11. *pp.* 139–159, *Sept.,* 1937. *In English.*—The problem of expressing the rate of variation of energy of the secondary undulations in a bay as a function of its size and form is discussed. Fourteen bays in Japan are examined. The damping factor for each bay is calculated, and the correlation of the damping factor and the shape of the bay is examined. W. A. R.

547. Free Oscillations of Water in a Basin with Smooth Boundaries. K. Hidaka. *Geophys. Mag., Tokyo,* 11. *pp.* 161–163, *Sept.,* 1937. *In English.*—The problem of free tidal motion in a basin of any given shape is undertaken. An approximate solution can be obtained unless the shape is extremely complicated. If the basin is not of uniform depth the Ritz method or the perturbation method may be applied. W. A. R.

548. Abnormal Thermal Stratification of Inland Lakes. S. Yoshimura. *Imp. Acad. Tokyo, Proc.* 13. *pp.* 316–319, *Oct.,* 1937. *In English.*—Inland lakes in the Northern Hemisphere show four kinds of abnormal thermal stratification ; water at a higher temperature than 4° C. below a surface which is at 4° C., a maximum or a minimum temperature at a middle layer, or two or more maxima or minima in a middle layer. These abnormal effects occur at different periods of the year and are bound up with three kinds of chemical stratification, which are biochemical, non-biochemical or a mixture of the two. A table is given showing the phenomena in lakes in Europe and Asia, especially in Japan, during the four seasons of the year. H. M. B.

LAND, PHYSICS OF THE.

549. Earth's Interior as Inferred from Terrestrial Magnetism. A. G. McNish. *Am. Geophys. Union, Trans. pp.* 43–50, 1937.—Former theories for the earth's magnetic state are not considered consistent with the assumed high temperature of the interior and the latter is questioned. Secular changes show that large fluctuations, which progress rapidly in geological time, occur in the magnetic condition of matter at great depths, indicating that the earth's interior is not static. Study of magnetic fields due to electric currents induced by diurnal variations and magnetic storms indicates that at depths of 200 km. the electrical conductivity increases greatly relative to that of surface rocks. If thermal and electric conductivity follow the Wiedemann-Franz relationship the earth's interior may be much cooler than is supposed. Speculations in this connection suggest that the temperature of the earth's centre may have been 2200° C. when convection cooling ceased. R. S. R.

550. Disturbance of the Temperature Gradient in the Earth's Crust by Inequalities of Height. H. Jeffreys. *Roy. Astron. Soc., M.N., Geophys. Supplement,* 4. *pp.* 308–312, *Jan.*, 1938.

551. Flow of a Granular Mass. K. Takahasi. *Geophys. Mag., Tokyo,* 11. *pp.* 165–175, *Sept.*, 1937.—The flow of sand through a wooden channel was investigated, and two modes of flow, corresponding to the laminar and turbulent flow in hydrodynamics, were observed. The velocity of the flow is given by $v = c\sqrt{gw}$ tan θ (for $\theta > \theta_c$) and $v = c^1\sqrt{gw}$ $(\tan\theta - 0{\cdot}7\tan\theta_c)$ (for $\theta_r < \theta < \theta_c$), where w is the width of the channel, θ its inclination, θ_c the boundary between the two kinds of flow, and θ_r the angle at which the sand can no longer run. Photographs of the material in the two states of flow are given. The effect of using different materials was studied. On increasing the cohesion between the sand particles by adding sulphur, the range of the first relation was extended but the second relation remained unchanged. R. F. A.

552. Soil Respiration. M. Diem. *Gerlands Beitr. z. Geophys.* 51. 2–3. *pp.* 145–166, 1937.—After referring to the nature of the phenomenon of soil respiration the author proceeds to describe a new method of observing it. The apparatus used consisted of an iron tube 8 mm. wide sunk in the soil to various depths, a manometer and an observation vessel with pump. Possible sources of error in the various parts of the apparatus are carefully examined, and the calibration of the arrangement described. Three different types of sand have been investigated and as a result no connection is found between the *Bodenatmung* and the volume of the pores of the soil. The laboratory investigation was extended by placing different thicknesses of turf over the sand in the observation vessel. Examples of observations made in the open are also recorded, the registrations of pressure variations obtained in these cases at various depths and in different soils being reproduced. A. E. M. G.

553. Shape-Sorting of Sand Grains by Wind Action. G. R. MacCarthy and J. W. Huddle. *Am. J. Sci.* 35. *pp.* 64–73, *Jan.*, 1938.—This paper presents experimental evidence showing that much of the superior roundness of eolian sands as compared with sands of other types is due to a process of shape-sorting. The experiments indicate that the wind transports sand grains chiefly by saltation and that this method of transportation favours the rounder grains. AUTHORS.

See also Abstract 545.

METEOROLOGY.

554. Deposition of Radioactive Elements from the Air by Aliverti's Method. G. Rosa. *Gerlands Beitr. z. Geophys.* 51. 2–3. *pp.* 286–297, 1937. *In Italian.*—Experiments are performed with Aliverti's apparatus [see Abstract 2096 (1936)], taking air containing a measured quantity of Rn in a container and drawing it at a velocity of 1 l./min. through the apparatus; then mixing this air with 60 to 120 times its volume of atmospheric air and again drawing it at 60 to 120 l./min. through the apparatus. The quantity of Rn deposited in each case is found to be the same within experimental error, which refutes Macek's idea that the amount of Rn deposits depends on the time it remains in the apparatus, and points to all the Rn being attached to dust particles. The method is then compared with that using a double ionisation chamber and agrees so well that it is concluded that Aliverti's method can be used as a direct and absolute method for measuring atmospheric radioactivity. H. M. B.

555. Observation of Atmospheric Ozone, North Japan, at Total Eclipse, 19th June, 1936. Y. Kawabata. *Geophys. Mag., Tokyo,* 11. *pp.* 111–116, *Sept.,* 1937. *In English.*—The observations in this investigation were made with a quartz prism spectrograph. A description of the method used is given. The author then proceeds to discuss the interpretation of the spectrograms. The relation between log D (D = density and so a measure of the incoming solar intensity) and zenith distance for a number of wave-lengths is given both in tabular form and by diagram. It is concluded from the investigation that the amount of atmospheric O_3 diminished during the time of total eclipse. The observations suffered to a certain extent on account of unfavourable weather conditions.
A. E. M. G.

556. Ultra-Violet Absorption Spectrum of Atmospheric Ozone. G. Déjardin and A. Arnulf. *Comptes Rendus,* 205. *pp.* 1000–1002, *Nov.* 22, 1937.—In a previous communication [see Abstract 117 (1938)] the authors showed that there existed differences in the u.v. absorption spectrum of atmospheric O_3 and that observed in the laboratory at ordinary temperatures. They are now able to give in tabular form a large number of absorption maxima for atmospheric O_3 between 3700 and 3135 Å. This, they consider, indicates that no appreciable difference exists in this region between atmospheric O_3 and that in the laboratory. On the other hand it is pointed out that the atmospheric minima are more transparent than those in the spectrum of O_3 in the laboratory. [See following Abstract.] A. E. M. G.

557. Atmospheric Absorption and the Absorption Coefficients of Ozone in the Visible Spectrum. G. Déjardin, A. Arnulf and R. Falgon. *Comptes Rendus,* 205. *pp.* 1086–1088, *Nov.* 29, 1937.—If the mean temperature of atmospheric O_3 be taken as −35° C. then in a determination of the total quantity of O_3 present in the upper atmosphere account must be taken of the variation with change in temperature of the absorption coefficients in the visible spectrum. This shows that it is necessary to revise the results found by Wulf and Deming for the Chappuis bands. The method of observation used by the authors [see Abstract 117 (1938)] permitted them to examine the interval 6500–3100 Å. Between 4800–3600 Å molecular diffusion alone occurs. In the other portion the Chappuis bands are found on the absorption curves, principal maxima occurring at 5350, 5700, 5975 and 6300 Å. From these and the intervening minima the thickness of the O_3 layer is calculated. Consistent results are found. Determinations in the region of the Huggins bands also give values corresponding to those in the region of the Chappuis bands when the influence of temperature on the absorption coefficients in that region is taken into account. [See preceding Abstract.] A. E. M. G.

558. Properties of Ozone and their Geophysical Consequences. E. Vassy. *Ann. de Physique,* 8. *pp.* 679–777, *Dec.,* 1937.—Following an introduction in which the different types of absorption bands investigated and the technique employed in the researches, are referred to, the author proceeds to discuss the effect of temperature on the absorption spectrum of O_3. Temperatures are varied from + 20° to − 80° C., and the effects on the Huggins, Hartley and Chappuis bands dealt with separately. The behaviour of the absorption coefficients when temperature is above the normal is also investigated. In the second section the author proceeds to the study of atmospheric O_3. From the previous section the mean temperature of the O_3 of the atmosphere can be found and as conditions to a height of 30 km. are known the mean temperature and O_3 content above that level are determined. The third section is devoted to a consideration of the decomposition of O_3 at ordinary temperatures and also at temperatures between 95° and 156° C. These results so obtained lead to the conclusion that O_3 does not exist at heights above about 60 km. and that the electrons in auroræ are not responsible for its formation. Diagrams and tables illustrate the paper. A. E. M. G.

559. Relations between Insolation and the Components of Total Radiation in the Climate of Paris. C. E. Brazier. *Comptes Rendus*, 205. *pp.* 1249–1251, *Dec.* 13, 1937.—The total energy, G, arriving on 1 sq. cm. of the earth's surface consists of two portions, (1) S, the radiation direct from the sun, and (2) D, the solar radiation diffused by the whole of the celestial vault. The determination of the three quantities, G, S and D is difficult but it is simplified if one determines the duration of insolation by a pyrheliograph, and if the fractions δ/Δ (fraction of insolation), S/G_0 (fraction of direct insolation) and D/G_0 (fraction of diffuse radiation) be found. A table gives these fractions round the solstices and the equinoxes from measurements obtained at Parc Saint-Maur. From this a mathematical expression is found giving a definite relation between δ/Δ and S/G_0. The relation between δ/Δ and D/G_0 is much less exact. A. E. M. G.

***560. Thermoelectric Actinometer with Built-in String Galvanometer. L. W. Pollak.** *Gerlands Beitr. z. Geophys.* 51. 4. *pp.* 365–374, 1937.—After a discussion of the previously known bimetallic and thermoelectric actinometers a new thermoelectric actinometer is described. A Moll-thermopile of the dimensions 13×9 mm^2. is connected to an Edelmann string galvanometer of special construction. Both instruments together are enclosed in a metal case. A view-finder enables the observer to adjust the thermopile with regard to the position of the sun. The actinometer combines small inertia (1–3 sec.) with high variable sensitivity and a negligible zero shift. The temperature coefficient of the thermopile is zero. As the actinometer is relatively insensitive to vibrations, it can be used on moving vehicles of all kinds. L. K.

561. Weather Forecasting. P. Berger. *Arch. des Sciences*, 19. *pp.* 203–222, *Sept.–Oct.*, 1937.—Reference is first made to pre-war methods of forecasting and to the method of " fronts " introduced by the Norwegian school in 1911. Thereafter the author proceeds to discuss the value of observations made at the surface of the earth, pressure, temperature humidity and wind, showing how these elements depend upon latitude, elevation above sea level, origin of air masses, etc. Observations made on board aeroplanes in the free atmosphere between the ground and a height of 6000 m. are next examined. The points of view from which each such sounding may be studied and methods of representing the results on charts are given. From these charts it is possible to deduce the movements of the principal air currents, and their developments. This method of analysis of atmospheric conditions appears to the author to afford the best basis for forecasting so far devised. A. E. M. G.

562. Long Range Weather Forecasting. H. C. Willett. *J. of Applied Physics*, 8. *pp.* 807–814, *Dec.*, 1937.—The author after indicating what is implied by the term long range forecasting points out that the methods used for this purpose may be arranged in two groups (1) statistical,

(2) synoptic. Regarding the former as of doubtful value he proceeds to discuss the synoptic method. During the last year daily charts of the complete northern hemisphere have been prepared and examined at the Massachusetts Institute of Technology. The conclusions arrived at from their study are summarised. While the information for the surface is fairly complete it is shown that more information is required concerning the upper atmosphere. The problem of the heat balance of the atmosphere must also be thoroughly investigated before a satisfactory method of long range forecasting can be developed. A. E. M. G.

563. Oscillations of the Atmosphere. B. Haurwitz. *Gerlands Beitr. z. Geophys.* 51. 2–3. *pp.* 195–233, 1937. *In English.*—In this discussion the atmosphere is assumed to be autobarotropic. The general equations of motion of such an atmosphere are derived. From these the free oscillations and the form of the surface deformation can be obtained. A study of the oscillations in one layer show that on a non-rotating globe for certain definite surface temperatures, oscillations have a period of half a sidereal day. The general case for such oscillations on a rotating globe is also discussed, and the effect of rotation and the form of the surface deformation are given in tabular form. The author then proceeds to deal with oscillations in two layers, the atmosphere being supposed divided by an internal surface of discontinuity. Longer waves appear, and the internal and surface waves in both layers are studied, and results given in tables. The periods of tesseral oscillations corresponding to a surface temperature of 10° C. are next investigated and the results tabulated. Oscillations in both one layer and two layers are discussed. The author concludes that the discussions indicate that the oscillations of any autobarotropic atmosphere whether they follow an adiabatic or any other law are analogous to the oscillations of an ocean of depth $D = RT_0/g$ where T_0 is the surface temperature. A. E. M. G.

564. Thermodynamics of Duststorms. B. N. Sreenivasaiah and N. K. Sur. *Current Science*, 6. *pp.* 209–212, *Nov.*, 1937.—The duststorms investigated occur in North West India, and the authors point out that they take place mainly in summer and show characteristics very similar to those of thunderstorms. A table giving the monthly frequencies of storms occurring between 1924 and 1930 at Agra shows a maximum in May, a slightly smaller number occurring in June. Meteorographs were released in the summer of 1932 to study the mechanism of the duststorm. Two records relating to 28th June, 1932, are reproduced and discussed. The investigation indicates that the occurrence of duststorms is associated with a state of latent instability, but that before the storm can take place a suitable agency or trigger is required such as insolation causing a high lapse rate. The paper closes with a short discussion on the seasonal variation of duststorms. A. E. M. G.

565. Instability in Fluid Layers when the Lower Surface is Heated. S. L. Malurkar. *Gerlands Beitr. z. Geophys.* 51. 2–3. *pp.* 270–277, 1937. *In English.*—Reference is made to results obtained earlier by the author and others and the theory is given to determine (1) the nature of the temperature-height curve for a given temperature difference, and (2) the maximum temperature difference possible in a given height interval for a given temperature distribution. It was found that when the temperature difference near the ground decreases according to a hyperbolic sine curve the actual temperature difference that can be maintained in a given height interval is greater than if the temperature distribution is linear. The investigations would be similar when the lapse rate decreases continuously with height above the ground. The distribution of temperature with height has also to be specified when considering the maximum temperature difference in a given height. Results will be published shortly of an application of this investigation to the atmosphere. R. S. R.

566. Land and Sea Breezes. H. Arakawa and M. Utsugi. *Geophys. Mag., Tokyo,* 11. *pp.* 97–104, *Sept.*, 1937. *In English.*—Starting from the two-dimensional equations of fluid motion the author gives equations which, along with boundary conditions, suffice for the solution of this problem. The appropriate boundary conditions are inserted and the values of the wind components and the horizontal pressure differences of sea-level readings of the barometer at the surface are found for three different values of ν, the eddy viscosity. The complete circulation given by the theory is shown by diagram, and also the vertical distribution of horizontal velocities. The author in conclusion considers that though certain factors are left out in the development of the theory, the main features of the phenomena have been obtained. A. E. M. G.

567. Rate of Condensation of Dew. G. Yamamoto. *Geophys. Mag., Tokyo,* 11. *pp.* 91–96, *Sept.*, 1937. *In English.*—Applying G. I. Taylor's theory of the wet and dry bulb hygrometer, the author derives a formula which gives the rate at which dew or frost is condensed. It is further shown that the theoretical value of the constant in this formula agrees with its value determined experimentally. An empirical formula giving the *total* quantity of dew falling in one night is next considered and data from the period April, 1934, to March, 1935, enable numerical values to be given to the constants in the formula. A simple expression is then obtained from which it is easy to calculate the total quantity of dew. The author hopes that this may be widely tested. A. E. M. G.

568. Diffuse Light from the Sky. I. A. Khvostikov. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 17. 4. *pp.* 195–197, 1937. *In French.*—Observations were made in the substratosphere at a height of from 8 to 10 km. The distribution of energy in the spectrum is measured. Comparison with the theoretical curve, calculated from Rayleigh's fourth power law for dispersion shows that the diffuse light of the atmosphere is richer in blue rays than this law requires ; a law with an exponent $n = 5\cdot3$ in place of $n = 4$ will fit the results. The degree of polarisation for different wave-lengths is also measured. Experiments were made on the 9th and the 22nd of March and the differences observed are regarded as being due to the motion of the aerostat. The degree of polarisation diminishes towards the blue end of the spectrum. An explanation, based on the existence of secondary diffusion, is put forward and discussed. G. G.

569. Geometrical Theory of Haloes. Part V. E. W. Woolard. *Monthly Weather Rev.* 65. *pp.* 301–302, *Aug.*, 1937.—In this section the author considers images produced by simple reflection and treats the cases where the reflecting plane is (*a*) vertical, (*b*) horizontal. The production of images by prismatic refraction with internal reflection is next referred to and the solution indicated. [For Part IV see Abstract 4426 (1937).] A. E. M. G.

***570. Telephotometer for Atmospheric Transmission. L. J. Collier and W. G. A. Taylor.** *Journ. Sci. Instruments,* 15. *pp.* 5–17, *Jan.*, 1938.—The paper describes a " Maxwellian view " type of telephotometer designed for measurements of atmospheric transmission. The accuracy of measurements obtained with this instrument compares favourably with that given by other methods of measurement. Over distances up to 8000 ft. the instrument does not require the use of light sources of great intensity. The telephotometer and its accessory apparatus are readily transportable. In using the instrument care must be taken to avoid error due to the Stiles-Crawford effect; but provided this and other sources of systematic error are avoided, the error in determining atmospheric transmission should not, under favourable conditions, exceed 5%. AUTHORS.

See also Abstracts 515, 580, 685, 896.

SEISMOLOGY.

571. Correlation of Frequencies of Seismic Disturbances with the Hour Angle of the Moon. H. T. Stetson. *Am. Phil. Soc., Proc.* 78. 2. *pp.* 411–424, 1937.—The possibility that periodic tidal stresses in the earth's crust should be reflected in the frequency with which seismic disturbances occur has been investigated by various workers, usually from the point of view of phases of the moon or with a view to correlation of earthquake frequencies with distances of the epicentre from the sub-lunar point. Results from the former method of treatment have for the most part been conflicting, and the results from the latter method of analysis have been subject to a fortuitous distribution owing to the relatively few occasions when the moon can be near the zenith of the epicentre. The present investigation, based on some 2,000 major earthquakes, seeks a possible correlation with lunar hour angle alone, which avoids the above-mentioned difficulty. When the seismic disturbances are restricted to major earthquakes recorded over 80° from the epicentre, and confined to the Philippine Island group and the Japanese Archipelago, two maxima are suggested falling approximately 12 hours apart, one corresponding to lunar time 8 hours, and the other to lunar time 20 hours. These occurrences are not far from the time of maximum tidal stress. More significant are the results of a study of 150 deep-focus earthquakes with origins 100 km. or more below the surface. The frequency distribution of these deep-focus earthquakes is compared with a sine curve corresponding to the horizontal tidal force at the epicentres. A least-square solution shows the sum of the squares of the residuals from the most probable sine curve to be 1/4 as large as would be the case were there but a chance distribution based on an arithmetic mean of the hourly frequency. Results, therefore, indicate a distinct tendency for major seismic disturbances to follow preferential positions of the moon with maxima occurring near the times when the horizontal component of the tidal force is a maximum. AUTHOR.

572. Seismic Waves and Block Structure of the Earth's Crust. K. Takahasi. *Geophys. Mag., Tokyo,* 11. *pp.* 117–138, *Sept.,* 1937. *In English.*—Assuming that the earth has a block structure instead of a continuous one, it is shewn that important effects on the energy problem result. Examination of earthquake data would seem to indicate that the crust really has a block structure. W. A. R.

573. Method of Production of Earthquakes. E. Rothé and E. Peterschmitt. *Comptes Rendus,* 205. *pp.* 870–871, *Nov.* 8, 1937.—A comparison of many results at Uccle and Strasburg and to a less extent, for Hamburg, Kew and Stuttgart shows that for West Europe in general the first impetus for distant earthquakes is the same. For Sverdlovsk this holds with some exceptions. Numerous differences exist between West Europe and Zi-ka-Wei. The theory of Ishimoto and Hazegawa provides an explanation of the differences, and the areas where compressions or dilatations occur are quoted. R. S. R.

574. Southern Earthquakes and the Core Waves. H. Jeffreys. *Roy. Astron. Soc., M.N., Geophys. Supplement,* 4. *pp.* 281–308, *Jan.,* 1938. —Observations of various of 28 earthquakes in the southern hemisphere during the past ten years at various of 118 stations are discussed, and the reliability of the observations thereat determined. The difference in P times of Pacific earthquakes is possibly due to a greater cooling effect beneath that ocean. The core waves (PKP, SKS, PKS, SKP, ScSPKP, PKP$_2$, and PcPPKP) are discussed and the observations of PKP and SKS found satisfactory, those of the others insufficient. The Z phenomenon is striking especially in Pacific earthquakes, and is explicable in most cases by slight focal depth. A seismological station on Easter Island is recommended. C. A. S.

***575. Constants of Galitzin Seismograph in Presence of Reaction. J. Rybner.** *Gerlands Beitr. z. Geophys,* 51. 4. *pp.* 375–401, 1937.—In the theory of the electromagnetic seismograph the reaction of the motion of the galvanometer coil upon the motion of the pendulum is mostly neglected. However, it has lately been shown by Schmerwitz and by Wenner and McComb that the influence of the reaction on the magnification is quite perceptible, even in case of the ordinary Galitzin seismograph. The present paper shows that in the tests usually employed for the determination of the instrumental constants, the effect of the reaction is of the same order of magnitude as that of the deviations of the frequencies and dampings from the Galitzin condition $n = n_1 = \epsilon = \epsilon_1$. The formulæ of Galitzin and Somville therefore give misleading results, unless they are extended to account for the reaction. As the reaction (the coupling coefficient) is an unknown quantity, this extension requires an extra test besides the usual "knocking test." Two methods are proposed, and the necessary formulæ developed. Finally, the influence exerted on the general performance of the seismograph by the reaction and by small deviations of the frequencies and dampings from the Galitzin condition is studied, and the formulæ obtained illustrated by curves. AUTHOR.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

576. Atmospheric Electric Field and Air Mass Conditions. H. Arakawa. *Geophys. Mag., Tokyo,* 11. *pp.* 105–110, *Sept.,* 1937. *In English.*—The values of electric potential gradient occurring under different air mass conditions are examined, the data being obtained from observations made at Kakioka 1932–35 and at Misima 1933–35. Under continental polar air mass the potential gradient is higher than under maritime air mass. The annual variations are also examined. The maximum potential gradient is found when the climate is determined by the prevalence of the monsoons. Individual cases are examined and illustrated by charts and tables. A. E. M. G.

***577. Atmospheric Electricity at the College-Fairbanks Polar Year Station. K. L. Sherman.** *Terr. Mag.* 42. *pp.* 371–390, *Dec.,* 1937.—The elements observed in the period Oct., 1932, to Aug., 1933, inclusive, were (1) air-potential, (2) air conductivity (in both cases continuous record being made), (3) number of positive and negative ions, and (4) number of condensation nuclei. A complete description of the station and the apparatus used to determine each element is given. Summaries of the recorded elements are set out in a series of tables and values are seen to be in agreement with those found in lower latitudes at land stations relatively free from variable sources of pollution. The electrode-effect appears to be important at this station and must be taken into account when interpreting the relations between the elements. This is apparently due to the extremely calm conditions prevailing. Examination for relationship between auroral displays and potential gradient is being continued. A. E. M. G.

578. World-Wide Changes in Potential Gradient. G. R. Wait and J. W. Mauchly. *Am. Geophys. Union, Trans. pp.* 169–170, 1937.—The percentage deviation of potential gradient in 1935 from the 11-year mean of 1924–34 has been obtained for Watheroo, Huancaya and Ebro and the results also from other observatories have been analysed statistically. The evidence supports the view of a universal effect in the year to year variations of potential gradient although definite conclusions cannot be drawn yet. The data are to be examined further and more observatories included. By multivariate correlation methods relations between potential gradient and other phenomena may be obtained. R. S. R.

***579. Continuous Registration of Specific Number of Ions in the Atmosphere. H. Greinacher and W. Klein.** *Gerlands Beitr. z. Geophys.* 51. 2–3. *pp.* 298–307, 1937.—The apparatus is based on Ebert's ion-aspirator method, which consists essentially of a string electrometer attached to an ionisation chamber; the cylindrical outer electrode of this is kept at a constant potential. The string is illuminated by a lamp and its motion registered photographically on a rotating drum. Each half hour the measuring system is earthed, the lamp extinguished for a moment, and the charge on the outer electrode reversed. Precautions are taken to make the apparatus as free from error as possible and also easy to work. From a knowledge of the electrometer sensitivity and the capacity of the system, the number of ions/cc. of the air drawn through is calculated. H. M. B.

580. Air-Earth Current, Visibility, Relative Humidity and Mass-Exchanger. H. Grieger. *Gerlands Beitr. z. Geophys.* 51. 4. *pp.* 325–334, 1937.—The air-earth current as deduced from the number of light ions is much smaller than as measured directly, and is too small even when the effect of medium and large ions is included. Its variation with visibility, relative humidity and mass-exchange is discussed. The difference is attributed to " other components " of the air-earth current. A method for measuring the electrode effect of the earth's surface by means of an ion counter for light ions is described. C. A. S.

581. Dissemination of Magnetic Data of American-Operated Magnetic Observatories. E. O. Hulburt, S. S. Kirby, A. K. Ludy and A. G. McNish. *Am. Geophys. Union, Trans. pp.* 155–157, 1937.—In order to be more representative, instead of only the Cheltenham figures, values are given for seven widely distributed American-controlled stations. The scale is extended to 0, 0·5, 1, 1·5, and 2 and each half of the day is dealt with separately. These figures are averaged for the seven stations and the resulting 14 figures for each week are issued in *Science Service.*
R. S. R.

582. New Approach to Study of Terrestrial Solar Relationships. J. W. Mauchly. *Am. Geophys. Union, Trans. pp.* 171–174, 1937.—Difficulties in dealing with these relationships are first discussed. An example is given in the use of multivariate correlation analysis for this purpose employing 6-months series over the period 1910–34 for magnetic activity measure of Bartels, the international magnetic character number, the areas of solar prominences, the Ca flocculi in the neighbourhood of sunspots, the two classifications of Ca flocculi. Vector correlation as used by Hotelling is mentioned and examples are given of agreement by canonised variates. R. S. R.

583. Regular Progressive Changes of the Magnetic Field of Diurnal Variations of Terrestrial Magnetism. Part I. M. Hasegawa and Y. Tamura. *Imp. Acad. Tokyo, Proc.* 13. *pp.* 311–315, *Oct.*, 1937. *In English.*—The diurnal variation (d.v.) of the terrestrial magnetism is studied to find whether the zonal component exists in the average state of d.v. ; this problem is related to the problem of the existence of progressive changes in the mean state of the magnetic field of d.v. General expressions of Fourier's coefficients *a* and *b* are given as functions of latitude and longitude and curves of these components shown for the same latitude and longitude for the Autumn 1905, also zonal terms (a_t and b_t) and rotating terms ($a_{2\lambda}$ and $b_{2\lambda}$) for different seasons in the Northern Hemisphere. The magnetic field of d.v. undergoes a regular diurnal change with time during its revolution round the earth, this is termed the universal diurnal (u.d.). The variation of u.d. is comparable with that of the mean d.v., so there is no doubt as to its reality. Only 24-hr. terms of the harmonic analysis have been taken, since for 12-hr. and higher terms lack of necessary data increases the difficulties. H. M. B.

584. Determination of Magnetic Inclination with an Earth-Inductor. J. Egedal. *Terr. Mag.* 42. *pp.* 367–370, *Dec.*, 1937.—The method used at the Rude Skov Observatory to obtain more accurate determinations of the magnetic inclination is described, and the need in general of accurate determinations of the inclination is emphasised. AUTHOR.

585. Lunar Effect on Earth Currents. P. Rougerie. *Comptes Rendus*, 205. *pp.* 1252–1253, *Dec.* 13, 1937.—This continues previous work [see Abstract 210 (1935)]. In order to determine whether there exist both diurnal and semi-diurnal lunar waves, a period from May 25 to Nov. 5, 1893, has been examined. Only the semi-diurnal wave is established and its mean amplitude stated. An expression for the variations of the e.m.f. in this wave is given. The amplitudes of this variation appear to depend on the position of the moon, maxima at the time of perigee and positive declination and minima at times of apogee and negative declination. A. E. M. G.

586. Heating of the Ionosphere by Electric Currents Associated with Geomagnetic Variations. S. Chapman. *Terr. Mag.* 42. *pp.* 355–358, *Dec.*, 1937.—A calculation is made of the heating-effect in the ionosphere of the electric currents that are responsible for the solar daily magnetic variation. Contrary to a suggestion made long ago by Schuster, they are found to be quite insignificant. It seems possible, however, that the intense and concentrated electric currents that flow along the auroral zone during magnetic storms may appreciably heat the air there ; but it is suggested that such heating is likely to be exceeded by more direct heating due to degradation into thermal energy of part of the kinetic energy of the incoming ionising particles. These heating-effects would produce convective motions that may possibly make an appreciable contribution to the e.m.f.s responsible for the electric current-system of polar magnetic disturbance. AUTHOR.

587. Heating of the Earth and Oceans by Induced Electric Currents. S. Chapman. *Terr. Mag.* 42. *pp.* 359–360, *Dec.*, 1937.—Estimates are made of the heating-effect of the electric currents induced in the earth and in the oceans by the transient variations of the earth's magnetic field; the effect is found to be quite insignificant. AUTHOR.

***588. Improved Inductor-Compass. R. Gunn.** *Terr. Mag.* 42. *pp.* 363–366, *Dec.*, 1937.—A rugged type inductor-compass having a period of less than a second is described. A gravitationally oriented magnet is so arranged adjacent to an inductor turning about a fixed axis that the induced potentials, due to the existence of a vertical component of the earth's magnetic field, are neutralised. A new type of commutator particularly suitable for very low potentials and currents is described. The compass is particularly valuable for steering aircraft or small boats. AUTHOR.

See also Abstract 549.

RADIOACTIVITY.

589. Extreme Intervals Between Radioactive Emissions. Part II. E. J. Gumbel. *J. de Physique et le Radium*, 8. *pp.* 446–452, *Nov.*, 1937.—Experiments according to the method of Chevalier and Rosenblum [see Abstract 2931 (1933)] are described in detail. They are then discussed with reference to the theory in Part I [see Abstract 4908 (1937)], showing substantial agreement therewith, though further precise observations are desirable. C. A. S.

590. Influence of the Absorption in the Interior of a Radioactive Preparation on the Radiation Emitted. M. Holuba. *Akad. Wiss. Wien, Ber.* 146. 2*a*. 3–4. *pp.* 285–290, 1937.—The correction has been obtained which is to be applied to the characteristic absorption for the radiation of a cylindrically shaped radioactive preparation. For the normal form of the radium standard preparation it is found that with consideration of the absorption in the interior of a radioactive salt and the absorption by the glass tube in a tube of 0·266 cm. clear width and 0·27 cm. thickness of wall the proportion of the actual radiation to that which would be emitted if no absorption took place is $V = 0{\cdot}99033$. V is a function of the length of the tube. J. J. S.

591. Chemical Investigation of Short-lived Artificial Radio-elements. A. Polessitsky. *Phys. Zeits. d. Sowjetunion.* 12. 3. *pp.* 339–342, 1937. *In English.*—Chemical methods for the examination of the short-lived products of three reactions are described pointing with considerable certainty to the following results: (1) The product of half-life 40 sec. resulting from $^{23}_{11}\mathrm{Na} + ^{1}_{0}n$ is definitely not $^{4}_{2}\mathrm{He} + ^{20}_{9}\mathrm{F}$ but almost certainly $^{1}_{1}\mathrm{H} + ^{23}_{10}\mathrm{Ne}$, only Ne and/or He being detected. (2) That of half-life 8 sec. from $^{19}_{9}\mathrm{F} + ^{1}_{0}n$ is $^{4}_{2}\mathrm{He} + ^{16}_{7}\mathrm{N}$ and not $^{1}_{1}\mathrm{H} + ^{19}_{8}\mathrm{O}$. (3) That of half-life 0·9 sec. from $^{9}_{4}\mathrm{Be} + ^{1}_{0}n$ is $^{4}_{2}\mathrm{He} + ^{6}_{2}\mathrm{He}$ and not $^{6}_{3}\mathrm{Li} + ^{4}_{1}\mathrm{H}$. C. A. S.

592. Identification of Ra, MsThI and RdTh in Sealed Preparations. G. V. Gorškov and V. N. Ionov. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 17. 1–2. *pp.* 15–18, 1937. *In English.*—The nuclear photo-effect and the existence of a photo-nuclear threshold for D and for Be is used to determine the relative intensities of γ-rays present in sealed preparations of Ra, MsThI and RdTh. The experiments are being continued in an attempt to set up standard conditions of measurement. F. C. C.

593. Nuclear Transformations and Cosmic Radiation. W. Bothe, W. Gentner, H. Maier-Leibnitz, W. Maurer, E. Wilhelmy and K. Schmeiser. *Zeits. f. techn. Physik*, 18. 12. *pp.* 538–541, 1937. *Phys. Zeits.* 38. *pp.* 964–967, *Dec.* 1, 1937.—The results of 5 separate investigations are communicated : (1) Wilhelmy reports the observation of " resonance " phenomena in the emission of protons and α-particles by bombardment of $_7N^{14}$, $_8O^{16}$, $_9F^{19}$ and $_{16}S^{32}$ with neutrons ; by " resonance " emission is meant the emission of particles in a series of discrete energy groups ; (2) Mauser reports on observation of " resonance " absorption in the transformation of B by bombardment with α-particles and with emission of neutrons. The " resonance " absorption energies are in good agreement with those expected from Wilhelmy's measurements of " resonant " emission energies ; (3) Gentner's investigations concern the building up of Li, B, F, Na and Al nuclei of the $(4n-1)$ type by bombardment with protons and the nature of the γ-radiation from these (p, γ) processes. A table is given of the observed " resonant " energies of penetration of protons into these nuclei. (4) Bothe, Maier-Leibnitz and Mauser describe experiments made with a view to elucidating a difficulty which arises in interpreting the reaction of B^{10} (α, p) C^{13} and which finds a most rational explanation on the assumption of the existence of a metastable C^{13} nucleus. (5) Schmeiser and Bothe report investigations of secondary cosmic radiation of small angular divergence which lend support to the correlation of this radiation with the second maximum of the Rossi curve. J. E. K.

594. Nuclear Disintegrations Produced by Cosmic Rays. R. B. Brode and M. A. Starr. *Phys. Rev.* 53. *pp.* 3–5, *Jan.* 1, 1938.—From a study of 20,500 Wilson cloud chamber photographs, ten nuclear disintegrations have been identified in which heavily ionising tracks are produced. These disintegrations are associated with the cosmic radiation as they are usually observed in time coincidence with the passage of other cosmic-ray particles through the chamber. The ejection of a number of heavy particles from a single source is interpreted as an " evaporation " from a highly excited nucleus. AUTHORS.

595. Resonance Effects in (α, *n*) Nuclear Transformation. E. Fünfer. *Zeits. f. techn. Physik*, 18. 12. *pp.* 541–543, 1937. *Phys. Zeits.* 38. *pp.* 967–969, *Dec.* 1, 1937.—By means of the energetic α-radiation of ThC′ the excitation curves of the neutron emission of N and A bombarded by α-rays are investigated. It is shown in the case of both these elements that the neutron emission is not a continuous function of the α-particle energy but that the liberation of neutrons takes place in narrow resonance regions outside of which no neutron emission can be observed. The total extent of these resonant regions is found to be about 40 kV, but it may be much less than this as the experimental arrangement may introduce an inhomogeneity of the α-ray energy of similar magnitude. J. E. K.

596. Ionising Power of Atomic Nuclei Emitted in Nuclear Transformation Processes. F. Kirchner, H. Neuert and O. Laaff. *Zeits. f. techn. Physik*, 18. 12. *pp.* 543–547, 1937. *Phys. Zeits.* 38. *pp.* 969–973, *Dec.* 1, 1937.—By means of an ionisation chamber and proportional amplifier the ionisation by various nuclear particles emitted in artificial disintegration processes is measured. In the disintegration of Be by protons two kinds of particle are detected by their differing ionising properties—

α-particles and deuterons—and the range of the deuteron is found to be $0 \cdot 5$ to $1 \cdot 0$ mm. bigger than that of the α-particle. The ionisation of the deuteron is compared with those of the triton and proton in the process D(D ; p)T. The maximum ionising powers of H, D and T are the same within the limits of accuracy of measurement and about 45% of that of the α-particle ; the maxima occur at 2 mm., 4 mm. and 6 mm. respectively from the end of the range. The He^3 particles arising from the transformation $Li^6(p\,;\,\alpha)He^3$ have a maximum ionisation at $3 \cdot 5$ mm. from the end of the range which is about 3% to 5% less than that of the α-particles. J. E. K.

597. Nuclear Reaction Be(α, n). New Method of Determining the Mass of the Neutron. J. Crussard and S. Gorodetzky. *Comptes Rendus*, 205. *pp.* 1060–1062, *Nov.* 29, 1937.—Po is placed at the centres of hemispheres of $2 \cdot 8$ and 10 cm. dia., coated internally with Be, externally with paraffin. The air pressure within the hemisphere can be varied. A portion of the neutrons thus slackened by the paraffin, are received in an ionisation chamber. The outputs of neutrons in each hemisphere separately are plotted against the mean free path (and thence against the energies) of the incident α-rays. The minimum energy for which emission of neutrons is observable is $2 \cdot 1 \times 10^6$ eV. The phenomena observed are best interpreted on the assumption that the reaction is ${}^9_4\mathrm{Be} + {}^4_2\mathrm{He} \rightarrow 3\,{}^4_2\mathrm{He} + {}^1_0n + Q^1$. Assuming $Q^1 = -\,2 \cdot 1 \times 10^6$ eV, ${}^9_4\mathrm{Be} = 9 \cdot 01500$ and ${}^4_2\mathrm{He} = 4 \cdot 00408$, ${}^1_0n = 1 \cdot 0090$. C. A. S.

598. Energies of Electrons and Positrons Emitted in Certain Nuclear Reactions. C. Magnan. *Comptes Rendus*, 205. *pp.* 1147–1149, *Dec.* 6, 1937.—Determined by the method of magnetic focussing the energy limit of the positrons emitted on bombarding F (in CaF_2) with α-particles from Po, ${}^{19}_9\mathrm{F} + {}^4_2\mathrm{He} \rightarrow {}^{22}_{11}\mathrm{Na}$ (period 3 years) $+ {}^0_1n$ [see Abstract 4250 (1937)] is $0 \cdot 6 \times 10^6$ eV. That of the positrons from ${}^{23}_{11}\mathrm{Na} + {}^4_2\mathrm{He} \rightarrow {}^{26}_{13}\mathrm{Al}$ (period 7 sec.) $+ {}^0_1n$ is $4 \cdot 6 \times 10^6$ eV [see Abstract 2826 (1934)] ; of those from ${}^{41}_{19}\mathrm{K} + {}^4_2\mathrm{He} \rightarrow {}^{44}_{21}\mathrm{Sc}$ (period 52 hr.) $+ {}^1_0n$, and/or ${}^{39}_{19}\mathrm{K} + {}^4_2\mathrm{He} \rightarrow {}^{42}_{21}\mathrm{Sc}$ (period 4 hr.) $+ {}^1_0n$ is $1 \cdot 9 \times 10^6$ eV [see Abstract 4248 (1937)]. α bombardment of Cl yielded nothing, but the positron spectrum from KCl and NaCl contains three sharp maxima with $H\rho = 2460$, 4305 and 6355. The negative electron spectrum contains two maxima with $H\rho = 2665$ and 6355. It is suggested that these " peaks " are connected with materialisation of γ photons attributable to Cl, which would give γ-rays of energies $1 \cdot 7$, $2 \cdot 7$ and $3 \cdot 9 \times 10^6$ eV, which correspond fairly with the differences in the energies of protons ($7 \cdot 6$, $5 \cdot 4$ and $3 \cdot 8 \times 10^6$ eV) from ${}^{35}_{17}\mathrm{Cl} + {}^4_2\mathrm{He} \rightarrow {}^{38}_{18}\mathrm{A} + {}^1_1\mathrm{H}$ [see Abstract 8(1937)], which are $3 \cdot 8$, $2 \cdot 2$ and $1 \cdot 6 \times 10^6$ eV.
C. A. S.

599. Disintegrations Induced by High-Energy Electrons. J. Solomon. *Comptes Rendus*, 205. *pp*, 1231–1232, *Dec.* 13, 1937.—A calculation of the disintegration probability previously made on the basis of the Hartree model [see Abstract 2170 (1936)] is extended by the use of the new Bohr model in which all the nuclear processes are treated as a many-body problem instead of a single body as in the Hartree model. Results lead to a disintegration cross-section appreciably lower than in the former case, but of the same order of magnitude. N. M. B.

600. Excitation Function and Energy Distribution of Neutrons Emitted from Boron by Bombardment with α-Particles from Po. W. Maurer. *Zeits. f. Physik*, 107. 11–12. *pp.* 721–729, 1937.—The excitation curve for the emission of neutrons by B on bombardment with α-particles from Po show 8 resonance levels of sharpness about

500 kV. The isotopes B^{10} and B^{11} contribute, the latter having 6 resonance levels and giving the greater total yield. The remaining 2 levels, attributed to B^{10}, are at $R_{\alpha}=3\cdot 0$ and $1\cdot 8$ cm. In accordance with Bohr's theory, sharp resonance levels are observed even with α-particles having energies greater than the potential barrier of B. The energy distribution of the neutrons was examined with a pressure chamber, the maximum energy being $5\cdot 35 \pm 0\cdot 25$ eMV. The energy balance of $+ 0\cdot 4$ eMV was in good agreement with the expected value. F. C. C.

601. Production of Neutrons by Bombardment of Beryllium with α-Particles. T. Bjerge. *Roy. Soc., Proc.* 164*A*. *pp*. 243–256, *Jan*. 21, 1938.—In the energy spectrum of the neutrons from beryllium bombarded with α-particles there are present some groups with energies of several million electron-volts. These are accounted for by the process $^{9}_{4}\mathrm{Be} + ^{4}_{2}\mathrm{He} \rightarrow ^{12}_{6}\mathrm{C} + ^{1}_{0}n$. The $^{12}_{6}\mathrm{C}$ may be left in an excited state and afterwards emit a γ-quantum. There is also, as shown by Auger and others, a neutron group of energies of the order of *c*. 100,000 eV. Auger gave reasons for supposing that these neutrons are created in a process, where the incident α-particle first transfers some energy to the $^{9}_{4}\mathrm{Be}$, which then disintegrates in the following way : $^{9}_{4}\mathrm{Be} \rightarrow 2^{4}_{2}\mathrm{He} + ^{1}_{0}n$. This view is supported by the ideas of Bohr on nuclear reactions. The present paper describes experiments which give the yield of the faster and slower neutron group and of the γ-rays as a function of the α-particle energy. It is shown that the slower group is not accompanied by γ-rays, and that it begins to be emitted at the α-particle energy which is just necessary for the second process indicated above to take place. AUTHOR.

602. Resonance Emergence of Protons and α-Particles. E. Wilhelmy. *Zeits. f. Physik*, 107. 11–12. *pp*. 769–779, 1937.—In nuclear transformations with rapid neutrons of continuous energy distribution there were observed in various elements discrete groups of protons (with S) and α-rays (with N, O, F, & S). These groups whose energies lie between about $0\cdot 5$ and 5 eMV are explained as resonance emergence of the protons or α-particles. J. J. S.

603. Artificial Radioactivity Produced by Slow Neutrons on Sb. K. Alexeeva. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 17. 1–2. *pp*. 13–14, 1937. *In French*.—In addition to an activity of period about $2\cdot 5$ d. reported by previous workers, an activity with a long period of about 45 ± 5 d. is found when Sb is bombarded with slow neutrons. An absorption curve gives a value of about $0\cdot 3$ mm. of Al for the upper limit of energy of the β-rays emitted. Various suggestions are made as to the nature of the nuclear reactions involved. F. C. C.

604. Artificial Radioactivity of Tantalum. O. Oldenberg. *Phys. Rev.* 53. *pp*. 35–39, *Jan*. 1, 1938.—Radioactivity has been induced in Ta by slow neutrons, fast neutrons, and fast deuterons. (1) Slow neutron capture leads to Ta^{182} with a lifetime of 97 days. (2) Fast neutron bombardment excites, in addition, an $8\cdot 2$-hour period with the emission of electrons, *K* radiation of Ta, and γ-rays. The process responsible for these effects is probably the capture of one neutron with the ejection of two neutrons. The product nucleus, Ta^{180}, goes over to Hf^{180} largely by *K* electron capture ; in this process either γ-rays are emitted or by their internal conversion extranuclear electrons ejected. (3) Deuteron bombardment of Ta leads to a decay curve affected to such an extent by impurities that the Ta activity cannot be observed clearly. AUTHOR.

605. Radioactivity in Silver Induced by Fast Neutrons. M. L. Pool. *Phys. Rev.* 53. *pp.* 116–123, *Jan.* 15, 1938.—Radioactive silver, Ag^{112}, has been produced by fast neutron bombardment of Cd^{112} and In^{115}. A half-life period of 3·2 hr. is observed with the upper limit of the electron β-ray spectrum at 2·2 eMV. γ-rays are also emitted, the number per β-ray is about four. The radioactive Ag^{106}, produced by fast neutron bombardment of Ag^{107}, has a positron β-ray spectrum upper limit of 1·9 eMV and an electron β-ray spectrum upper limit of 1·3 eMV. The half-life periods are respectively 24·5 min. and 8·2 days. The former emits no γ-rays other than the annihilation radiation. The latter emits a complex γ-ray spectrum. The number of γ-rays per β-ray is about 35. Nuclear *K* electron capture is offered to explain this anomalously high γ to β ratio. A total of 20 nuclear reactions all leading to the production of radioactive Ag have been observed. AUTHOR.

606. Fluctuations in the Range of Corpuscular Rays. S. Titeica. *Soc. Roumaine de Physique, Bull.* 38. 69. *pp.* 81–100, 1937.—Using Bloch's method, theoretical investigation is made of the energy losses causing straggling in a beam of rapid particles passing through matter. A formula is derived which is in satisfactory agreement with the experimental results of Mano for α-particles. F. C. C.

607. Electric Charge of α-Particles in Helium. F. Viehfeger. *Akad. Wiss. Wien, Ber.* 146. 2*a*. 3–4. *pp.* 273–284, 1937.—The charge carried by α-particles of velocity $1{\cdot}08 \times 10^9$ cm./sec. in He and in air, is examined. The mean free path for the loss of an electron is 11·3 times greater in He than in air but at the velocity under consideration the ratio of the mean free paths for capture and loss of electrons is not very different for He, air or mica. F. C. C.

608. Collisions of α-Particles with Neon and Deuterium Nuclei. J. T. McCarthy. *Phys. Rev.* 53. *pp.* 30–34, *Jan.* 1, 1938.—The tracks of about 600,000 Th C and C′ α-particles were photographed in a Wilson cloud chamber filled with a mixture of Ne and D. An analysis of the elastic collisions with Ne atoms gave points on a range-velocity diagram which fitted Eaton's curve fairly well except at the lower end. Reasons are given for thinking that this curve should be lowered slightly in the region of small velocities. A range-velocity curve is obtained from the collisions with deuterons. On the very reasonable assumption that, for a given velocity, the ranges of two isotopes are proportional to their masses, this curve indicates than Mano's calculations for protons are correct even for small velocities. It is shown that these collisions are elastic even when a high energy α-particle imparts considerable energy to a deuteron. No sign of inelastic collisions with either deuterons or Ne atoms was obtained, although some were expected for the latter. The possible reasons for their non-appearance are discussed. AUTHOR.

***609. Continuous β-Spectrum of RaE. A. Flammersfeld.** *Zeits. f. techn. Physik*, 18. 12. *pp.* 547–549, 1937. *Phys. Zeits.* 38. *pp.* 973–975, *Dec.* 1, 1937.—A spectrograph free from scattering effects is described which permits detection of β-particles of only 12 kV energy. Preparations are produced with exceptionally thin layers the emission from which is used to investigate the effects of scattering by walls and slits of the spectrograph and of the backwards scattering from the preparation support. With RaE preparation deposited on thin mica foil an energy distribution curve is measured which is free from all secondary influences from 100 kV up to the upper limit of about 1200 kV. Comparison of this curve with those given by formulæ deduced theoretically by Fermi and Konopinski-Uhlenbeck show that the former formula gives an incorrect result throughout the range, whilst the latter affords good agreement with experiment for medium energies down to 100 kV but considerable discrepancies towards the upper energy limit. J. E. K.

610. β- and γ-Radiation. J. Surugue. *Ann. de Physique*, 8. *pp.* 484–554, *Dec.*, 1937.—After a detailed account of the making of the permanent magnet (of Co-steel containing 30% Co) used, and the method of focusing the rays of β spectra of the active deposits of thoron (97 lines, 14 new), and of actinon (15 lines), also the spectrum of RdAc and its derivatives (131 lines, over 50 new) are given with their energies, intensities, and (in most cases) origins, together with level-schemes of the transformations $\mathrm{ThB} \xrightarrow[\gamma]{\beta} \mathrm{ThC}$, $\mathrm{ThC} \xrightarrow[\gamma]{\alpha} \mathrm{ThC''}$, $\mathrm{ThC''} \xrightarrow[\gamma]{\beta} \mathrm{Pb}$, and $\mathrm{RdAc} \rightarrow \mathrm{AcX} \rightarrow \mathrm{An} \rightarrow \mathrm{AcA}$. Previous results are confirmed and extended, though in some cases with slight but systematic differences, *e.g.*, the present results are always about 1% less than those of Rosenblum, where the same lines have been measured by both. [See Abstract 2662 (1936).] C. A. S.

611. Absorption Limits for the Primary β-Particles of Mesothorium 2 and Uranium X_2. N. Feather. *Cambridge Phil. Soc., Proc.* 34. *pp.* 115–119, *Jan.*, 1938.—The absorption limits for the primary β-particles of mesothorium 2 and uranium X_2 have been determined using modified tube counters of various types. Results in good agreement with previous single determinations with gold-leaf electroscopes and at variance with deductions from expansion chamber observations show the need for caution in fixing limiting energies in β disintegrations from measurements on a relatively small number of tracks. AUTHOR.

612. Energy of γ-Rays from Penetration of Secondary Electrons. G. Bernardini and S. Franchetti. *Ricerca Scientifica*, 2. *pp.* 406–412, *Oct.*, 1937.—Using two coincidence counters with thin Al walls, a method is devised for determining the energy of primary γ-rays from the absorption curve of the liberated secondary electrons. The method is rapid and is considered suitable for an initial determination of the γ-ray energy associated with nuclear transmutations. F. C. C.

613. Photonuclear Absorption of Hard γ-Rays. J. Rotblat. *J. de Physique et le Radium*, 8. *pp.* 477–480, *Nov.*, 1937.—Examination is made of the photonuclear action of the hard γ-rays from RaC incident upon Be, using the activity excited in Ag as a detector of the emitted neutrons. Using γ-ray absorbers of Pb, Cu and Al, exponential absorption curves are obtained, showing that only the harder γ-rays are effective. The mean energy of the effective rays was about 1·06 eMV. The results differ from those of Gentner and it is suggested that reflection of neutrons by the absorber may account for the discrepancy. F. C. C.

***614. Production, Characteristics and Reliability of Geiger-Müller Counters. O. S. Duffendack, H. Lifschutz and M. M. Slawsky.** *Phys. Rev.* 52. *pp.* 1231–1237, *Dec.* 15, 1937.—A technique for the production of reliable Geiger-Müller counters is described. By the use of pure H_2 and by cleaning the electrodes by sputtering in a glow discharge in H_2 previous to filling the tubes with H_2, tubes with plateaux of 400 V are produced. Cu, Ni and W have been found suitable for kathode cylinders while Al was not. Tubes filled with pure A, pure O_2, or air were found to give many spurious counts. An extensive series of reliability

tests is described which shows that carefully made counter tubes used in properly designed circuits give completely reliable quantitative data.
AUTHORS.

✱615. Lecture Apparatus for Artificial Disintegration using Canal Rays. R. Döpel. *Zeits. f. techn. Physik,* 18. 12. *pp.* 553–555, 1937. *Phys. Zeits.* 38. *pp.* 979–981, *Dec.* 1, 1937.—An inexpensive lecture apparatus which demonstrates nuclear disintegration, neutron production and the production of artificial radioactivity is described. In the arrangement considered, a discharge tube works at a few thousand volts, generated by an influence machine or by some other method. The apparatus is based essentially on the deuteron-deuteron interaction. F. C. C.

✱616. L.V. Nuclear Research Apparatus. L. J. Haworth, L. D. P. King, C. T. Zahn and N. P. Heydenburg. *Rev. Sci. Instruments,* 8. *pp.* 486–493, *Dec.,* 1937.—An apparatus designed for nuclear studies at energies up to somewhat in excess of 300 kV is described. The potentials are derived from a voltage quadrupling circuit using laboratory constructed rectifiers and condensers. The accelerating tube, of the cascaded type, and its accompanying ion source furnish steady, well-focussed proton beams. Effective proton intensities of 12, 40 and 60 μA are available in the beams of ionic masses 1, 2 and 3 respectively. Voltages are measured by a resistance voltmeter which has been calibrated to an accuracy of a few tenths of 1%. Certain peculiarities of the ion source which effect the homogeneity of the ion energies are discussed. AUTHORS.

✱617. Design and Operation of a Large Cyclotron. M. C. Henderson and M. G. White. *Rev. Sci. Instruments,* 9. *pp.* 19–30, *Jan.,* 1938.—A large cyclotron is described with particular reference to magnet design, " ion-source " characteristics, r.f. requirements, optimum shape of the magnetic field, and the distribution in range of the high energy α-particle beam. Increasing the " ion-source " electron current above 400 mA was found to lower the efficiency of production of high speed ions. Investigation of the r.f. power losses showed that the anodes of the oscillators absorbed 35% of the total power, while the tank oil across the " dees " and the " dees " themselves took, respectively, 30% and 21%. The optimum arrangement of iron shims used for magnetic field correction was such that the average field at the middle of the pole was decidedly higher than at the edge. AUTHORS.

618. Range of H-Rays by the Photographic Method. M. Blau and H. Wambacher. *Akad. Wiss. Wien, Ber.* 146. 2*a*. 3–4. *pp.* 259–272, 1937.—Experiments were carried out with different types of photographic films on the registration of tracks of H-particles by the photographic method. From a large amount of statistical material on tertiary protons, liberated by neutrons from a Po-Be source, 64 tracks were obtained of protons ejected by neutrons of 7·9–10 eMV. Two series of data (which are regarded as of a preliminary nature) on the length and direction of the tracks were derived and the results were in satisfactory agreement with theory. F. C. C.

See also Abstracts 388, 542, 554, 723, 757.

RADIATION.

ABSORPTION.

✱619. Comparative Study of Some Violet Absorbing Filters. P.L. Bayley. *J.O.S.A.* 27. *pp.* 303–304, *Aug.,* 1937.—No gelatin films of β-methyl esculetin were obtained which absorbed well at λ4046. The

Wratten 2A film is excellent for absorbing both λ4046 and λ4078. A rapid and very compact Raman apparatus may be made by enlarging one set of holes in a General Electric Raman outfit so as to hold a glass double-walled water cooling tube. The sample tube is wrapped with a layer of the 2A filter and placed inside the cooling tube. AUTHOR.

See also Abstracts 738, 826.

COLORIMETRY.

620. Accuracy of Trichromatic Colour Measurements. F. Lindmaier. *Akad. Wiss. Wien, Ber.* 145. 2*a*. 9–10. *pp*. 611–637, 1936.—The author distinguishes between the synthetic method of trichromatic colorimetry in which the test colour is matched with a mixture of three primary lights, and the analytic method in which three brightness matches are made between the test object and the source illuminating it, each match being made with one of a set of three standard colour filters interposed at the eye. It is admitted that the analytic method, unlike the synthetic, is not in fact rigorous and systematic deviations from the latter will occur. The various sources of error both physical and physiological which may arise in the practical realisation of the two methods are examined and the conclusion is drawn that the analytic method is more advantageous for comparative measurements, the synthetic for absolute measurements. W. S. S.

***621. Chromaticity Limitations of the Best Physically Realisable Three-Filter Photoelectric Colorimeter. J. A. van den Akker.** *J.O.S.A.* 27. *pp*. 401–407, *Dec*., 1937.—The theoretical requirements to be met by a photoelectric colorimeter capable of yielding I.C.I. tristimulus values, and relationships between tristimulus values and instrumental reflectances are given. For practical reasons, the correct photoelectric colorimeter must be equipped with four filters. It is commonly believed that a three-filter photoelectric colorimeter would be generally suitable for colour specification and colour matching; this is tested from the theoretical standpoint, and it is shown that the best physically realisable three-filter photoelectric colorimeter would suffer a fundamental chromaticity limitation. Relationships between the displacements of instrumental points on the chromaticity diagram and errors in the "red," green, and blue reflectances are given. Especial attention is given to errors originating in the assumption that the blue reflectance may be used in the evaluation of both the X and Z tristimulus values; maximal displacements associated with this assumption are given for a number of points on the diagram, and it is shown that actual chromaticity errors would be objectionably great for many colours of importance. The use of a three-filter photoelectric colorimeter as a colour comparator is discussed. AUTHOR.

***622. Objective Colorimeter for the Measurement of Slight Coloration and Cloudiness. H. Dreyer.** *Ann. d. Physik*, 30. 7. *pp*. 650–664, *Dec*., 1937.—The colorimeter, or more correctly the optical densitometer, was designed for measuring the concentration of dyes in very weak solution, this being a problem met with in determining the flow of rivers by introducing a relatively small quantity of dye at one point. Light from a source reached a photo-cell by one of two alternative paths, traversing either a length of the solvent or a length of the solution under test. The two paths were alternated rapidly with the aid of a rotating mirror sector disc. The alternating current from the photo-cell was suitably amplified and activated a telephone. The note in the telephone could be made inaudible by inserting the correct amount of an absorbing wedge in one of the two optical paths to bring to equality the intensities of the two light beams falling on the cell. Colour filters were used to restrict the radiation used to spectral regions where the dye showed maximal absorption. Data on the accuracy of the instrument when used to measure the concentrations of methylene blue and uranin A are reported. W. S. S.

***623. Calculator for Obtaining Tristimulus Values from Spectrophotometric Data. H. W. Swank and M. G. Mellon.** *J.O.S.A.* 27. *pp.* 414–415, *Dec.*, 1937.—The tristimulus values can be obtained from a spectrophotometric graph by adding the ordinates for a selected set of wavelengths, one set for each primary. The present device does this operation semi-automatically. A brass bar is moved at right angles to its length from a position in which it coincides with the wavelength axis of the graph to a position in which it intersects the graph at the first chosen ordinate. The distance traversed is recorded on a revolution counter. The bar is restored to the axis without operating the counter and the process is repeated for the second ordinate, and so on. The required value is proportional to the counter reading. W. S. S.

ELECTRO-OPTICAL AND MAGNETO-OPTICAL EFFECTS.

624. Electric Double Refraction of Liquefied Gases. R. Guillien. *Ann. de Physique*, 8. *pp.* 555–678, *Dec.*, 1937.—The electric double refraction of liquid O_2, N_2, H_2, CH_4 and C_2H_4 has been investigated in detail and a full description of the methods and apparatus used is given. The Kerr constants observed are positive and less than those calculated from the corresponding values in the gaseous state or from the depolarisation of the light diffused by the gases. The Kerr constant is studied in detail in connection with the absorption spectra for liquid O_2, pure or diluted with N_2. Its dispersion is normal, its thermal variation is slightly greater than that predicted by Langevin's theory. The deviations from the law of mixtures are small. The thermal variations of the Kerr constant observed for N_2 and C_2H_4 are less than the theoretical values. The specific Kerr constant of CH_4 is shown to be independent of temperature; this constancy can be explained in terms of the quantum theory. The author shows how the modifications of Langevin's theory in the case of liquids can account for the experimental results. R. L.

625. Temperature Variation of Magnetic Double Refraction in Acetone and Acetic Esters. J. B. Hawkes. *Phys. Rev.* 53. *pp.* 84–90, *Jan.* 1, 1938.—Measurement of the Cotton-Mouton coefficient at various temperatures between − 60° C. and 40° C. were made on acetone and several normal acetic esters. Under neutral environment the relationship for these materials is best represented by a straight line with a slope of the same sign but of much larger value than can be justified by the mathematical theory. This is interpreted as indicating a larger molecular interaction in the liquid than is assumed in the theory. In the presence of a freshly cleaned surface of copper, acetone shows a reversal of sign of the birefringence with decreasing temperature. Evidence in the case of amyl acetate indicates that there is no discontinuity in the Cotton-Mouton coefficient near the freezing point. AUTHOR.

626. Faraday Effect of Strong Electrolytes in Aqueous Solutions. Part VI. A. Okazaki. *Ryojun Coll. Eng., Mem.* 10. *pp.* 89–113, *Nov.*, 1937.—By the use of the data for the magneto-optical rotation of a number of electrolytes in aqueous solution obtained by other investigators, the variation with concentration of the corrected molecular rotation $M(D_2)$ has been studied. It has been found that the $M(D_2)$-values of HCl, HBr, HI, $CdCl_2$, $AlCl_3$, CsBr, $CdBr_2$, NH_4Br, CdI_2 and CH_3COOLi decrease with increasing concentration, while those of HNO_3, NH_4NO_3, H_2SO_4, $(NH_4)_2SO_4$, $HClO_3$, $LiClO_3$, HIO_3 and $LiIO_3$ increase and that of CH_3COOH is practically independent of the concentration. The $M(D_2)$-values at infinite dilution have been determined by graphical extrapolation. Most of them have proved to be given by the sum of the corrected ionic rotations. A correction is given to Part V [see Abstract 5508 (1936)]. AUTHOR.

See also Abstract 674.

EMISSION.

627. Radiation Emitted from Electron-Positron Pairs on Interaction with a Charge. A. Sokolow. *Phys. Zeits. d. Sowjetunion,* 12. 4. *pp.* 472–481, 1937. *In German.*—Mathematical. An expression for the interaction of a charge with the field of an electron-positron pair is deduced. The probability of emission of radiation is calculated. The expression leads to the view that showers might be produced if the energy were great enough. A. J. M.

628. Problem of the Existence of a Smallest Wave-Length. A. March. *Zeits. f. Physik,* 108. 1–2. *pp.* 128–136, 1937.—According to a theory previously advanced by the author [see Abstract 3917 (1937)] there should exist a lower limit for the wave-length of the photon which is conditioned by an indefiniteness in the world metric. It is now shown that the decline of the relative energy-loss of an electron by passage through metal plates, which was established by Blackett on the assumption of a smallest wave-length of $\lambda_0 = 6{\cdot}2 \times 16^{-13}$ cm. ($\pm$ 10%), may be explained in a manner free from objection. The same value is obtained from a discussion of the energy-loss evaluated from the spreading effect which an electron undergoes by passage through the atmosphere, in accordance with the analogous energy of shower particles which is likewise limited. H. H. Ho.

629. Theory of the Neutrino. Part II. J. Solomon. *J. de Physique et le Radium,* 8. *pp.* 433–438, *Nov.*, 1937.—Continuing a previous paper on the difficulties in the theory of the neutrino which were shown to be associated with uncertainty in the expressions to be used for the energies of interaction of different types of particle, the author here develops a theory of neutrinos introducing an operator generalising the different forms hitherto proposed for the interaction neutrino-electron. It is shown that by the proper choice of this operator it is possible to obtain accord between theory and experiment but the determination of the precise form of this operator is not yet possible. [For Part I see Abstract 3559 (1937).] W. S. S.

630. Collision of a High Energy Neutrino with a Neutron. S. Tomonaga and H. Tamaki. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 733. *pp.* 288–298, *Nov.*, 1937. *In English.*—A mathematical development is given of Heisenberg's theory of cosmic-ray showers [see Abstract 4678 (1936)], and exact numerical factors which can enter into expressions of cross-sections of first and second order processes in the collision of a high energy neutrino with a free neutron and the ratio of these cross-sections are calculated and discussed. When the energies concerned are very large a shower-like phenomenon can be expected, and the estimated limit of the incident neutrino energy beyond which the shower-process becomes important is of the order of 10^{12} eV. N. M. B.

631. Origin of Cosmic Radiation. Part II. H. Alfvén. *Zeits. f. Physik,* 107. 9–10. *pp.* 579–588, 1937.—The author carries further his previously developed theory that cosmic rays derive their energies from the cyclotron-like action of double stars [see Abstracts 2584 and 3504 (1937)]. He shows that if there is a weak magnetic field (say 10^{-11} gauss) in interstellar space within the galaxy, the most important properties of the cosmic radiation (particle energies, intensity, isotropic distribution etc.), can be explained from classical electrodynamics. D. H. F.

632. Nature of Cosmic-Ray Particles. Y. Nishina, M. Takeuchi and T. Ichimiya. *Phys. Rev.* 52. *pp.* 1198–1199, *Dec.* 1, 1937.—Experiments with a counter-controlled cloud-chamber containing a sheet of Pb 1·5 cm. thick, in a magnetic field, showed that at sea-level at Tokyo (geomagnetic latitude 25·4° N.) about 10–20% of the cosmic-ray particles recorded consist of electrons and positrons. It is believed, from considerations of penetrating power for Pb and of specific ionisation in relation to momentum ($H\rho$) that some at least must be due to particles heavier than electrons and lighter than protons. A further series of photographs with a 3·5 cm. block of Pb in the chamber revealed one track suitable for a mass-determination of the particle. It was found to be from 1/7 to 1/10 that of the proton. The results do not allow a decision whether the penetrating component of the cosmic radiation consists entirely of the new particles or partly of protons. D. H. F.

633. Heavy Particles in Cosmic Rays. V. Veksler and B. Isajev. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 17. 4. *pp.* 189–192, 1937. *In English.*—In view of the doubt concerning the heavy particles in cosmic radiation, the Elbrus Expedition took advantage of being able to investigate these particles at a height of 4250 m. above sea level. An apparatus consisting of proportional amplifiers and counters is described; this apparatus is suitable for the study of electronic showers in addition to heavy particles. Experiments are made with unshielded counters and with counters shielded with Fe (0·75 and 1·5 mm. thick) Al (3 mm. thick) and Pb plates. The experiments show the presence of strongly ionising particles which are absorbed by the Fe shields; their ionising power is from 10 to 15 times that of the cosmic electron. The experiments with the Al screens seem to indicate that these screens do not emit heavy particles in any appreciable number. [See following Abstract.] G. G.

634. Cosmic-Ray Showers. V. Veksler and B. Isajev. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 17·4. *pp.* 193–194, 1937. *In English.*—The methods used to study heavy particles [see preceding Abstract] have been applied to showers. About half the coincidences obtained were due to particles penetrating a 3 mm. Pb plate and these were assumed to be due to showers. This assumption is supported by a study of the number of coincidences for different thicknesses of Pb screens—the so-called curve of Rossi. This curve so obtained is very different from similar curves obtained at sea-level in that its maximum is shifted to greater thicknesses of screening material. Apparently 3 to 4 electrons take part in the collisions. G. G.

635. Energy Distribution in Cosmic-Ray Showers. K. Barschauskas. *Zeits. f. Physik*, 107. 11–12. *pp.* 713–718, 1937.—Under a thick concrete roof, which acted as a source of showers, double coincidences were measured with different separations of the counters at different distances from the roof. It was found that if the angular separation of the counters was greater than 7° with respect to the roof the rate was decreased when a plate of Pb was placed close over the counters; and that the rate was increased if the angle was less than 7°. It is concluded from this that, in the showers originating in the concrete, the rays near the axis of the shower are more likely to produce further showers in the Pb than are the more divergent ones. D. H. F.

636. Cosmic-Ray Showers. H. Geiger. *Zeits. f. techn. Physik*, 18. 12. *pp.* 510–517, 1937. *Phys. Zeits.* 38. *pp.* 936–943, *Dec.* 1, 1937.—Review of the present state of knowledge of cosmic-ray showers with special reference to coincidence experiments. The dependence of triple coincidences, in non-linear arrangements of counters, on the nature of the absorber and the material in which the shower originates, receives special discussion. F. C. C.

637. Production of Cosmic-Ray Showers in Lead. M. A. Starr. *Phys. Rev.* 53. *pp.* 6–14, *Jan.* 1, 1938.—Photographs were taken of cosmic-ray showers arising in lead plates of various thickness placed in turn inside a Geiger counter controlled cloud chamber. These showers are classified according to the number of particles in the shower and according to the manner of production, whether by an ionising particle or by non-ionising radiation. The average size of showers was found to increase with the plate thickness. Studies of the frequencies of showers of different sizes as a function of plate thickness show that electron-produced and photon-produced showers occur in approximately equal numbers and are of the same character. These facts give support to the theories of Carlson and Oppenheimer and of Bhabha and Heitler. They consider the shower to be the result of repeated subdivision of incident radiation through pair production by γ-rays and through radiative losses of high energy electrons giving rise to other γ-rays. 8% of the electrons striking lead plates near 7 mm. thick gave rise to showers. About an equal number of showers from γ-rays were present. AUTHOR.

638. Theoretical Investigation of Cosmic-Ray Data. H. Euler. *Zeits. f. techn. Physik*, 18. 12. *pp.* 517–525, 1937. *Phys. Zeits.* 38. *pp.* 943–951, *Dec.* 1, 1937.—General review of cosmic-ray data with special reference to (1) expansion chamber, ionisation chamber and tube counter data, (2) Hofmann collisions and (3) possible theoretical elementary processes, especially the theories of shower production of Bhabha and Heitler and of nuclear explosion proposed by Heisenberg. F. C. C.

639. Cosmic Rays and Latitude Effect. A. Ehmert. *Zeits. f. techn. Physik*, 18. 12. *pp.* 549–552, 1937. *Phys. Zeits.* 38. *pp.* 975–978, *Dec.* 1, 1937.—Review of the present state of knowledge of the latitude effect in cosmic-ray phenomena. Special attention is devoted to the analysis of the primary radiation absorption curve. F. C. C.

***640. Latitude Effect in Cosmic Radiation at High Altitudes. S. A. Korff, L. F. Curtiss and A. V. Astin.** *Phys. Rev.* 53. *pp.* 14–22, *Jan.* 1, 1938.—Measurements of cosmic-ray intensities in the equatorial and temperature regions are reported, and the instrument described. The apparatus consists of a single Geiger counter, the impulses of which are transmitted by radio to a ground station. The results are compared with high altitude electroscope measurements, and are found to agree satisfactorily. Flights up to 70,000 ft. were obtained in Peru. The results indicate that the intensity of cosmic radiation in the upper atmosphere in Peru is about half that at Washington. The component which produces about one-half the maximum total intensity of ionisation at high altitudes over Washington is cut out by the earth's magnetic field and does not reach the top of the atmosphere in Peru. The energy of this component lies between 3 and 12×10^9 eV. Analysis of the data shows agreement with the Carlson-Oppenheimer curves. The ionisation at high altitudes is shown to be in large part due to secondaries. AUTHORS.

***641. Latitude Effect for Cosmic-Ray Showers. H. V. Neher and W. H. Pickering.** *Phys. Rev.* 53. *pp.* 111–116, *Jan.* 15, 1938.—Cosmic-ray observations have been taken with Geiger counters on a voyage from San Francisco to Colombo *via* Japan and return *via* Australia. The apparatus used possesses some interesting features and is described at length. The latitude effect for vertical coincidences is found to be 14·5% in the region of the Dutch East Indies and 10% in the Pacific Ocean. The showers show a much smaller variation with latitude, only about 6% being found in the region of the East Indies. This result is interpreted as meaning that the latitude sensitive part of the radiation is not as efficient at producing showers as the nonlatitude sensitive radiation. Qualitatively, at least, such behaviour is consistent with the hypothesis that the latitude sensitive radiation is due to incoming electrons. AUTHORS.

642. Cosmic-Ray Observations in the Stratosphere. L. F. Curtiss, A. V. Astin, L. L. Stockmann, B. W. Brown and S. A. Korff. *Phys. Rev.* 53. *pp.* 23–29, *Jan.* 1, 1938.—With radio methods devised as a part of a programme for development of radiometeorographs, it has been found possible to record the response of a Geiger-Müller tube counter to cosmic rays at altitudes up to 116,000 feet. Records were made automatically by means of a recording receiver at a ground station. The results show a gradual rise in cosmic-ray intensity which is clearly evident at a pressure of about 500 millibars and then decreases slightly at a pressure of about 300 millibars after which the rise to maximum intensity at a pressure of about 100 millibars is very rapid. This maximum is about 150 times the count recorded near the ground level and is followed by a rapid decrease in counting rate at pressures below 100 millibars. At the highest altitude reached, approximately 116,000 feet, where the pressure is only 5 millibars, the counting rate falls to a value which is about the same as that observed at a pressure of 600 millibars. The general trend of these observations indicates that as the limit of the atmosphere is approached the counts continue to decrease, confirming the view which has been put forward by other observers that the greater part of cosmic-ray phenomena are due to secondary effects generated within our atmosphere. AUTHORS.

643. Penetrating Component of Cosmic Radiation. H. J. Bhabha. *Roy. Soc., Proc.* 164*A*. *pp.* 257–294, *Jan.* 21, 1938.—An analysis of the experimental data is carried through to show that a " breakdown " theory for radiation loss of electrons cannot explain (1) the latitude effect at sea level from latitudes of 35–50°, (2) the large number of particles found at sea level in the difference curves of Bowen, Millikan and Neher for charged particles of 10^{10} eV, (3) the shape of the transition curve for large bursts. All these facts can be explained by assuming that the penetrating component consists of new particles with masses between those of the electron and proton. But in order to explain the energy loss measurements of Blackett and Wilson, it must then be assumed that these particles suffer large energy losses in addition to the ordinary *Bremsstrahlung* which must vary in different substances as Z rather than Z^2, such as, for example, a change in the rest mass of the particles. The radiation loss and the pair-creation cross-sections are calculated taking screening into account accurately for " heavy " electrons. The frequency of the production of showers of different sizes by such heavy electrons as also the intensity of electrons in equilibrium with such particles forming a soft component are also calculated, and it is shown that though both these are somewhat larger in heavier elements, the variation is much less than a Z^2 law would give. A comparison with experiment gives the mass of the penetrating particles as of the order $100m$. If such heavy electrons can be created as usual in pairs, then a part of the hard component at sea level could consist of heavy electrons of mass $10m$ created by the soft component in the upper atmosphere. It is shown that there are reasons to suppose that the uppermost layers of the atmosphere are more absorbing than should be expected, from their mass. This may be due to the fact that the atoms in these layers are largely ionised, thus increasing the effective radiation and pair-creation cross-sections. AUTHOR.

***644. Point Source of Continuous Ultra-Violet Spectrum. F. Almasy.** *Helv. Phys. Acta,* 10. 6. *pp.* 471–474, 1937. *In German.*—A water-cooled, all-quartz hydrogen discharge lamp is described. The end of the tube in which the luminous discharge takes place is closed down to about 3·25 mm. in dia., and a porcelain disc, filling about 2/3 of the diameter of the tube, is mounted 6 mm. behind the opening. The light from the discharge in the rest of the tube is thus prevented from emerging from the opening, and the source becomes limited to a small chamber of the above dimensions. The intensity is very high considering this limitation, and the distribution about the axis is uniform over a usefully wide angle. D. H. F.

See also Abstracts 524, 593, 594, 599, 733.

FLUORESCENCE AND PHOSPHORESCENCE. LUMINESCENCE AND AFTERGLOW.

645. Fluorescence of Divalent Rare Earths. B. Karlik and K. Przibram. *Akad. Wiss. Wien, Ber.* 146. 2*a*. 3–4. *pp.* 209–221, 1937.—A survey of the so far observed wide fluorescence bands attributed to divalent rare earth ions—Eu (blue), Yb (yellow green), Sm (red), Tu (red). The Eu and Sm bands were observed at air temperatures while the Yb and Tu bands were observed at low temperatures only. In both pairs Eu–Sm and Yb–Tu the less stable ion gave the longer wave band. The infra-red lines of Sm discovered by Tomaschek have been found both in $EuCl_2$ preparations and in $CaSO_4$ + Sm preparations after Ra irradiation and are therefore considered as due to Sm^{++}. J. E.

646. Fluorescence of Divalent Rare Earths. K. Przibram. *Zeits. f. Physik,* 107. 9–10. *pp.* 709–712, 1937.—In a previous paper [see Abstract 5101 (1936)], it was surmised that a red band in fluorite was attributable to Sm though the presence of this could not be detected. An addition of 10^{-3} parts by weight of Sm to $CaSO_4$ gives this red band strongly after irradiation by Ra rays. Tu in the same concentration gives a band in the same place. It is considered that these bands are attributable to divalent ions. J. E.

647. Fluorescence in a Layer of Thickness Comparable to Wave-Lengths. F. S. Baryšanskaja. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 17. 3. *pp.* 99–102, 1937. *In French.*—Measurements on the fluorescence of fluorescein in solution in layers of thickness comparable to the wave-length of the light used give the following relation between intensity and concentration: $I = A.c.e^{-k(c-c_0)}$. J. E.

648. Influence of Temperature on the Fluorescence of Anthracene in Paraffin Oil. S. Gryglewicz. *Acta Physica Polonica,* 6. 3. *pp.* 210–217, 1937. *In German.*—The intensities of absorption and fluorescence emission are photometrically determined for a solution of anthracene in paraffin oil at different temperatures. The range of temperatures at which observations are made is from − 42° C. to + 120° C. The total absorption and emission respectively are determined from the obtained curves, and the ratio between absorbed and emitted intensity calculated. It is found that the intensity ratio is independent of the temperatures. L. K.

649. Quenching of Fluorescence of Dye Solutions by Foreign Substances. Part II. Influence of the Solvent. B. J. Sveshnikoff. *Acta Physicochimica,* 6. 5. *pp.* 755–766, 1937. *In English.*—Continuing previous work [see Abstract 2675 (1936)] the author investigates the quenching of fluorescence in relation to the viscosity of the solvent used. Experiments are described upon the quenching of rhodulin red by aniline in different alcohols and of fluorescein by KI in water-glycerin and sugar solutions, the Wawilow-Frank dependence upon viscosity being observed. Departures from this dependence are found in a series of experiments upon the quenching of rhodamin B by aniline in various solvents, but in this connection it is pointed out that change of solvent may also be expected to alter the mean life of the excited state and the energy of interaction between excited molecule and quenching agent. An experiment is therefore carried out in which the viscosity is altered only by raising the temperature. Uranine is chosen because its mean life is independent of temperature, and the expected dependence of quenching upon viscosity is observed. The resulted are discussed in relation to the theory of quenching. L. A. W.

650. Decay of Phosphorescence of ZnS at Various Temperatures. V. Antonov-Romanovskij. *Comptes Rendus (Doklady) de l'Acad des Sciences, U.S.S.R.* 17. 3. *pp.* 95–98, 1937. *In French.*—Continuing previous work [see Abstract 3144 (1936)] with individual small crystals of ZnS, it has been shown that from 25° to 100° C. the decay follows the law $I = A/(a + t)^a$ where A, *a* and are constant, depending on the phosphor. Over this range *a* is equal to 1·2 but above 147° C. the rate is greater and after a curve in the log I/log *t* line the value of *a* becomes 2. These results are not explicable on a simple bimolecular recombination of electrons and ions. As previously explained, however, the simple recombination would be affected by an impoverishment of ions which are nearest to electrons and by a variation of recombination probability with distance between ions and electrons. A study of the curves at the higher temperatures is taken to indicate that the probability of recombination depends on temperature according to $p_e = p_o \cdot e^{-\varepsilon/K_T}$. An attempt is made to criticise Muto's theory of phosphorescence. J. E.

651. Influence of an Electric Current on Phosphorescence of Semiconducting Zinc Sulphide. G. Déchêne. *Comptes Rendus,* 205. *pp.* 850–852, *Nov.* 8, 1937.—Variations in the intensity of the phosphorescence of ZnS screens under the influence of an electric current were examined by means of photo-cells. The mechanism of the phenomenon is associated with electron displacement due to the production of intense electric fields in the vicinity of the electrodes. [See Abstract 3837 (1935).] W. R. A.

652. Alkali-Halide Phosphors Containing Heavy Metals. R. Hilsch. *Phys. Zeits.* 38. *pp.* 1031–1034, *Dec.* 15, 1937.—In the simple alkali-halide lattices, even in single crystals, a very complicated molecular inclusion can be observed. No interpretation can yet be given for the optical processes which result from inclusion of complexes, but definite complexes can be held responsible for the appearance of absorption and emission. C. B. A.

653. Luminescence of Scapolite. E. Iwase. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 734. *pp.* 299–304, *Nov.,* 1937. *In English.*—From the measurements of interfacial angles, refractive index and specific gravity it was concluded that a grayish white short prismatic fluorescent mineral from Ontario was one species of scapolite. Its fluorescence seems to be intimately related to its paragenesis. Exposure to u.v. light produces a brilliant yellowish fluorescence in crystals which come from regions rich in quartz but that from regions rich in pyrrhotite seem to be destitute of fluorescence. Several fluorescent bands appear arranged in a regular manner in the orange and yellow. It is considered probable that the activator for the fluorescence is uranium. J. E.

654. Chemiluminescence of Phthalhydrazide Derivatives. C. N. Zellner and G. Dougherty. *Am. Chem. Soc., J.* 59. *pp.* 2580–2583, *Dec.,* 1937.—The preparation of a number of phthalhydrazide derivatives is described. The relative chemiluminescence of these derivatives upon oxidation in alkaline solution with NaOCl is measured. The effect of different substituents in the benzene ring, and in the hydrazide ring, on the intensity of the light emitted is pointed out. Measurements on the rate of oxidation of these derivatives were made, and the effect of OH-ion and inhibitors on the rate, and the light emitted is noted. AUTHORS.

See also Abstracts 668, 693, 695, 724.

INTERFERENCE, DIFFRACTION AND SCATTERING.

655. Intense Lighting and Interference Systems. F. Zernike. *Zeits. f. techn. Physik,* 18. 12. *p.* 568, 1937. *Phys. Zeits.* 38. *p.* 994, *Dec.* 1, 1937.—Preliminary notice of experiments on intense lighting of double-slit or biprism interferometers by multiple sources. The production of coherent or partly coherent sources is discussed. F. C. C.

656. Diffraction by a Body of Revolution Illuminated by a Point Source on the Axis. Part II. P. Barreca. *Arch. des Sciences,* 19. *pp.* 237–265, *Sept.–Oct.,* 1937.—A continuation of previous work. [See Abstract 3148 (1936).] W. S. S.

***657. Improved Diffraction Patterns. M. E. Hufford.** *J.O.S.A.* 27. *pp.* 408–410, *Dec.,* 1937.—By means of apparatus of unusual dimensions and a method of producing monochromatic light of exceedingly narrow range of wave-length, improved diffraction patterns have been produced. The photographs show much greater detail than is usual. An exceptional pattern produced by a square opening is shown. AUTHOR.

***658. Apparatus for Wave Theory Demonstrations. H. Greinacher.** *Helv. Phys. Acta*, 10. 6. *pp.* 490–494, 1937. *In German.*—The apparatus described consists essentially of two glass discs on one of which there are 12 pairs of black and clear sectors and on the other, 13 pairs. The discs are mounted on a common axis and can be rotated at different speeds by belts passing over conical driving shafts. If the discs are rotated at a high speed and the respective speeds adjusted, a dark segment appears which by suitable adjustment, can be made to remain stationary, in which case it is easily seen that $c = k\lambda$; then, in this case, from the Rayleigh equation $c_g = c - \lambda\, dc/d\lambda$, c_g the group velocity is zero, independently of the magnitude of the constant k. G. O. B.

***659. Films for Interferometer Mirrors. R. A. Fisher and J. R. Platt.** *Rev. Sci. Instruments*, 8. *pp.* 505–507, *Dec.*, 1937.—Metallic films deposited on interferometer mirrors must be uniform within very narrow limits, otherwise the phase shifts produced may be equivalent to a serious change in the figure of the mirror. It is concluded that a continuous ring-shaped source would produce greater uniformity of distribution over a limited plate area than any disposition of point sources within a vessel of reasonable size, whilst a moving point source should produce a distribution resembling that of the source just mentioned. Details are given of the apparatus devised for the work. A. H.

See also Abstract 671.

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

660. Grotthus and Einstein. W. D. Bancroft and R. C. Clapp. *Frank. Inst., J.* 225. *pp.* 23–43, *Jan.*, 1938.—The real nature of the law of photochemical equivalence is discussed. Three laws of photochemistry are then formulated, *viz.*, (i) Only those radiations which are absorbed by a substance can cause a chemical change in the system (Grotthus). (ii) All radiations which are absorbed by a substance (and only those radiations) tend to eliminate that substance. It is entirely a question of chemistry whether any reaction takes place or what the reaction products are (Bancroft). (iii) Light is absorbed discontinuously, by quanta, and not continuously (Einstein). Controlling conditions are specified; and the photochemistry of the following cases is discussed :—ketones, erythrosine, molecular hydrogen, dyestuffs, photovoltaic cells. No satisfactory statement can be made of what determines photochemical efficiency. The decomposition voltages of $CuSO_4$ and of Fehling's solution, and the effect of adding glucose to $CuSO_4$, are discussed. C. B. A.

661. Spectral Sensitivity of Photographic Emulsions. R. Mecke and F. Rose. *Zeits. f. techn. Physik*, 18. 11. *pp.* 390–393, 1937.—Shows how the DIN-sensitometer can be used, in conjunction with a series of appropriately chosen colour filters, to determine the spectral sensitivity curve of a photographic plate or, in fact, any other light-sensitive surface such as a photo-cell. Curves of spectral sensitivity between the wave-length limits 365 and 760 mμ are given for five types of plates and two photo-cells. J. W. T. W.

662. Spectral Sensitivity of Photographic Emulsions. B. Richter. *Zeits. f. wiss. Phot.* 36. *pp.* 251–265, *Oct.–Nov.*, 1937.—The spectral sensitivities of a number of commercial orthochromatic and panchromatic emulsions have been determined at 10 wave-lengths from λ4358 to λ6438, using Hg, Tl, Cd and Na lamps in conjunction with lineselecting filters. The materials were brush-developed in a *p*-aminophenol developer and sensitivities expressed in terms of the energy (thermopile measurements) required to give a density 0·1 above fog. The spectral sensitivities are plotted (*a*) in absolute measure, (*b*) relative to visual brightness, at the wave-lengths studied. L. V. C.

663. Silver Halide Layers without Protective Colloid. Lüppo-Cramer. *Zeits. f. wiss. Phot.* 36. *pp.* 265–268, *Oct.–Nov.*, 1937.—The coarse-grained layer sedimented from a gelatin-free AgBr suspension upon the upper surface of a horizontally immersed glass plate is much less sensitive (threshold sensitivity) than the fine-grained layer simultaneously-deposited on the under surface of the glass. Excess Br^- ions adsorbed to the AgBr are readily replaced by basic dyes (*e.g.*, phenosafranin and other desensitisers) but not by acid dyes. The relation of these observations to those arising in the presence of gelatin is briefly discussed. [See also Abstract 3536 (1937).] L. V. C.

664. Silver Bromide Layers Poor in Gelatin. Lüppo-Cramer. *Phot. Indust.* 35. *pp.* 1109–1111, *Oct.* 20, *and pp.* 1133–1134, *Oct.* 27, 1937.—Emulsions of the Schumann type (for u.v. photography), but with the sensitivity of commercial diapositive emulsions, have been prepared by diluting emulsions of the latter type and allowing them to sediment slowly upon horizontal glass plates. Much of the gelatin is adsorbed to the silver iodobromide grains and in consequence, as in normal gelatinohalide emulsions, the finer grains are less sensitive than the larger. L. V. C.

665. Theory of Photolysis of Silver Bromide and Photographic Latent Image. R. W. Gurney and N. F. Mott. *Roy. Soc., Proc.* 164*A*. *pp.* 151–167, *Jan.* 21, 1938.—An attempt is made to explain the photolysis of silver halides in terms of the concepts of atomic physics. The mechanism by which the Ag atoms formed by the light coagulate to form specks of metallic Ag is discussed. The ideas used in this discussion are then turned to the photographic latent image, and are shown to account qualitatively for the variation of developed density with temperature, and, for given exposure, with intensity of light. A brief discussion is given of the Herschel effect, and of sensitisation by dyes. AUTHORS.

666. Theory of Additive Three-Colour Photography. G. B. Harrison and R. G. Horner. *Phot. J.* 77. *pp.* 706–713, *Dec.*, 1937.—Mathematically considers the mechanism of additive three-colour photography, the results obtained showing that exact reproduction of all colours is impossible by any such process. The limited case of mosaic screen processes is also briefly examined, and the method of finding the most satisfactory filters, which is one of successive approximation, discussed. Finally, the results obtained are discussed, it being shown that the equations developed can be used to deduce the colour reproduction possible with any hypothetical or practical sets of taking and viewing filters. R. C. F.

***667. New Records from Electric Spark Photography. H. Schardin and W. Struth.** *Zeits. f. techn. Physik*, 18. 11. *pp.* 474–477, 1937.—An apparatus is mentioned which will give 24 successive pictures of very rapidly occurring phenomena which affords a picture frequency of several millions per sec. The apparatus is described as being developed from Cranz and others. Actual illustrations are given as reproductions of pictures taken of the transmission of a bullet through glass, armour plate, steel wire, plastic bodies, a water wall, and a large capacity water holder; also of explosions in air and the wave motion ensuing, wave phenomena from the muzzle of a gun, etc. The chief characteristic is the increase in speed of exposure and the use of a high speed kinematograph camera. S. G. B.

***668. Photography of Dark Hot Bodies. T. Takéuchi and T. Sugita.** *Imp. Acad. Tokyo, Proc.* 13. *pp.* 358–359, *Nov.*, 1937. *In English.*—A special phosphorescent plate is employed and this is excited by filtered u.v. light from a mercury lamp. The image of the dark hot body is projected on to the plate and this is then placed in contact with a panchromatic plate for a few minutes. The panchromatic plate is processed in the usual way. Photographs of moving bodies have been obtained by this method. A. H.

See also Abstracts 687, 712, 744.

PHOTOMETRY.

669. New Objective Method of Heterochromatic Photometry. J. Vorobeitchik. *Comptes Rendus*, 205. *pp.* 1222–1224, *Dec.* 13, 1937.—The method rests on the fact that by mixing in suitable proportions the radiations of two standard lamps of colour temperatures T and T^1 respectively, radiation is obtained having approximately the same energy distribution as that given by a lamp of any intermediate colour temperature. A mixture having the same colour temperature as the lamp to be measured is obtained by the aid of two rectifier photo-cells, one covered with a blue filter, the other with a red filter. A third cell serves for the measurement of relative intensity when the correct colour match has been obtained. W. S. S.

See also Abstract 570.

POLARISATION.

***670. Optical Properties of Polaroid for Visible Light. M. Grabau.** *J.O.S.A.* 27. *pp.* 420–424, *Dec.*, 1937.—Transmission and polarisation characteristics of Polaroid (registered name of a patented material) are given. Polaroid consists of small needle crystals embedded in a cellulose sheet so that the mean orientation of the crystals is aligned with one of the principal directions of vibration of light in the matrix. The degree of polarisation is nearly uniform within the visible region, and for a specimen with a degree of polarisation of about 0·998 the transmission was 0·37. Applications of Polaroid to photometry are discussed. H. G. C.

671. Double Scattering of Polarised X-Rays. P. Kirkpatrick. *Phys. Rev.* 52. *pp.* 1201–1209, *Dec.* 15, 1937.—Formulæ are derived for calculation of the intensity of twice scattered X-radiation emerging from a scattering body at 90° to an incident beam of arbitrary polarisation. Spherical and cylindrical scatterers are treated, and with the latter body the cases of primary radiation incident parallel and normal to the cylinder axis are separately considered. Thomson scattering is assumed but with approximate corrections for energy losses to recoil electrons. Certain aspects of the theory are amenable to experimental testing and have been satisfactorily checked. AUTHOR.

672. Study of Tertiary Amine Oxide Double Bond by Absorption Spectra and Rotatory Dispersion. H. S. French and C. M. Gens. *Am. Chem. Soc., J.* 59. *pp.* 2600–2603, *Dec.*, 1937.—Data are recorded for absorption spectra of alcoholic solutions of dimethylaniline oxide, the hydrochlorides of dimethylaniline oxide and of methyl ethyl aniline oxide, methyl ethyl-β-naphthylamine and its oxide, and for the rotatory dispersion of d-methyl ethyl-β-naphthylamine oxide, the preparation of this compound being described in detail. The results are discussed with reference to the dissymmetry of the CO group. C. B. A.

673. Theoretical Consideration of Flow Dichroism. S. Nikitine. *Comptes Rendus*, 205. *pp.* 1058–1060, *Nov.* 29, 1937.—The theory of the dichroism observed when molecules of colouring materials are oriented by flow of a viscous solution [see Abstract 4022 (1937)] is discussed mathematically. W. R. A.

***674. Improved Spectroradiometric Method and Apparatus for Measuring Small Polarisation Ellipticities. L. R. Ingersoll.** *J.O.S.A.* 27. *pp.* 411–413, *Dec.*, 1937.—A modification of the Sénarmont-Chauvin compensator for measuring small polarisation ellipticities has been applied to spectroradiometric work. Over the larger share of the usable spectral range of $0\cdot6\mu$ to $2\cdot0\mu$ the sensitivity is in a class with the best visual methods, and by some sacrifice of spectral purity may be made much more sensitive than any other known method. It has been applied in measuring the Kerr dispersion of CCl_4, which is found to follow the Havelock law very closely. [See also Abstract 4458 (1933).] AUTHOR.

See also Abstracts 448, 477, 727.

REFLECTION, REFRACTION AND DISPERSION.

675. Optical Constants of Rhodium. M. Auwärter. *Zeits. f. techn. Physik*, 18. 11. *pp.* 457–459, 1937.—Thick films of Rh were found to have a reflecting power practically independent of wave-length in the visible and infra-red regions while showing a comparatively small drop in reflecting power in the near u.v. The transmission of thin films was found to be remarkably constant in the visible region, even for films giving low transmissions. These properties make Rh superior to other metals of the Pt group for many optical purposes. Moreover, unlike Pt, Rh films show no ageing effects by time or temperature, and the films can be cleaned with a soft cloth. W. S. S.

***676. Geometrical Theory of the Spherical Mirror. J. Flügge.** *Zeits. f. Instrumentenk.* 57. *pp.* 495–500, *Dec.*, 1937.—The usual method for deriving the standard formulæ for reflection at a spherical mirror is criticised and a simple alternative is proposed. The aberrations are deduced by the same method, which is also applied to an aplanatic series of two mirrors. C. B. A.

***677. Mirror Systems. H. Schulz.** *Zeits. f. Instrumentenk.* 57. *p.* 501, *Dec.*, 1937.—Addendum. [See Abstract 3568 (1937).]

***678. Distortion-Free Mounted Lenses. J. Picht.** *Zeits. f. Instrumentenk.* 57. *pp.* 484–494, *Dec.*, 1937.—Errors in Flügge's calculations for a distortion-free mounted lens are pointed out and a more accurate treatment is given. [See Abstract 3023 (1935).] C. B. A.

679. Refractivity Intercept. Part II. S. S. Kurtz, Jr. and A. L. Ward. *Frank. Inst., J.* 224. *pp.* 697–728, *Dec.*, 1937.—The number and frequency of vibration of dispersion electrons in hydrocarbons are calculated to obtain an understanding of the refractive index/density relation on which the refractivity intercept is based [see Abstract 5547 (1936)]. The Sellmeier-Drude equation is used in making these calculations. It is found that the theoretical derivations of the Lorentz-Lorenz and Clausius-Mossotti equations are unsound and that neither the $(n^2-1)/(n^2-2)$ nor the $(\epsilon-1)/(\epsilon+2)$ form can be justified empirically, since they cannot correlate available experimental data for the effect of temperature and pressure on non-polar liquids. The data obtained are also reinterpreted in the light of wave mechanics. It is found that the best representation of the data is that given by the Eykman type of formula. A. H.

680. Anomalous Dispersion in the First Doublets of Cu and Au. L. Allegretti. *N. Cimento*, 14. *pp.* 337–342, *Aug.–Sept.–Oct.*, 1937.—In one of the arms of a Michelson interferometer a high-temperature chamber is inserted in which the vapour of Au or Cu can be obtained. By measuring the anomalous dispersion in the neighbourhood of a line, the number of dispersion electrons for this line can be determined. In this way the ratios of the numbers of dispersion electrons for the two components of the doublet can be found. For the first doublets of Cu and Au the ratios are 2·01 and 2·18, respectively. R. P.

681. Anomalous Dispersion of Didymium Glass. K. Prosad and R. P. Gupta. *Indian Journ. Phys.* 11. *pp.* 329–342, *Dec.*, 1937.—The paper deals with the application of the ray-displacement refractometer constructed by the authors [see Abstract 2600 (1937)], to the study of the anomalous dispersion of a sample of didymium glass. The accuracy of measurements claimed for this instrument has been fully substantiated by the location of positions of absorption bands of didymium glass, known from previous measurements. Further, the study has unmistakably located positions of other bands which photography had failed to reveal. AUTHORS.

682. Availability of Optical Glass in America. G. W. Morey. *J.O.S.A.* 28. *pp.* 5–7, *Jan.*, 1938.

683. Optical Glass Requirements of the Optical Industry. W. B. Rayton. *J.O.S.A.* 28. *pp.* 8–12, *Jan.*, 1938.—After defining optical glass, the requirements of the optical industry are discussed from the standpoints of quantity, quality and variety. Consumption is small but the demands in respect of quality are high. The variety of optical constants now available is great but the designer is in need of combinations of index of refraction and dispersion not now available. AUTHOR.

684. Optical Glass at the National Bureau of Standards. A. N. Finn. *J.O.S.A.* 28. *pp.* 13–17, *Jan.*, 1938.—A brief résumé is given of the work done by the National Bureau of Standards in connection with the manufacture of optical glass. The method of inspection for striæ is outlined, data on the reproducibility of refractivity, from melt to melt, are given, and some effects of annealing on refractivity are mentioned. Attention is directed to the fact that the raw materials needed for the manufacture of optical glass are all domestically available. AUTHOR.

685. Optical Illusions Produced by a Rotating Beacon. L. Dunoyer. *Comptes Rendus*, 205. *pp.* 867–869, *Nov.* 8, 1937.—Reference is made to results obtained by Colange and Le Grand [see Abstract 3574 (1937)]. A similar effect was observed in Paris when standing back to a rotating beacon and with the eyes fixed on the zenith. Apparently an anti-beacon exists near to the horizon but obscured by some such effect as fog. It was lost if the rotating beacon intersected clouds. The same physiological explanation holds. If the beacon is faced and the eyes are fixed on the zenith apparently beacon and anti-beacon are present and the beam, when at the zenith, appears concave to it. This is considered to be due to curvature of the retina and resulting distortion of the image. R. S. R.

See also Abstracts 395, 431, 736, 830.

SPECTROSCOPY.

686. Infra-Red Spectra of Iron, Titanium and Carbon. C. C. Kiess. *Bureau of Standards, J. of Research,* 20. *pp.* 33–37, *Jan.,* 1938.—New wave-lengths in the arc spectra of Fe and Ti have been recorded photographically with the type Z plates produced by the Kodak Research Laboratories. The long wave-length limits of these spectra have now been extended to the vicinity of 12000 Å. Many of the observed lines were predictable from previously known terms. Several apparently related groups of lines in Ti have revealed a new term, e'^3P, belonging to the third set and combining with terms of the middle set. Previously known lines in the spectrum of C have been photographed with high dispersion to obtain accurate wave-length values for use in identifying infra-red lines in the sun's spectrum. A new band in the infra-red system of CN has been found. AUTHOR.

687. New Method in Infra-Red Spectrography. M. Czerny and P. Mollet. *Zeits. f. techn. Physik,* 18. 12. *pp.* 582–584, 1937. *Phys. Zeits.* 38. *pp.* 1008–1010, *Dec.* 1, 1937.—A method of detecting the radiation in infra-red spectroscopy is described. The spectrum falls on a film of celluloid 0·1μ thick, covered with a film of paraffin perhaps 0·01μ in thickness, the celluloid being backed with a thin film of Al to act as absorber of the radiation; the whole is mounted in a vacuum of about 0·01 mm. Hg (the vapour pressure of paraffin at ordinary temperatures). Where spectral lines fall on the film the paraffin evaporates, producing in the paraffin film discontinuities which can be seen under suitable conditions of illumination. The process has been used for wave-lengths up to 10μ. It compares favourably as regards sensitivity and resolution with the usual thermal methods for detecting infra-red spectra, but is very much faster, as the whole spectrum is recorded at once, as in photographic methods. It is considerably slower than the photographic method over the limited infra-red region in which the latter is applicable. D. H. F.

688. Spark Spectra of Cæsium. R. Ricard, M. Givord and F. George. *Comptes Rendus,* 205. *pp.* 1229–1230, *Dec.* 13, 1937.—The spectrum of Cs was photographed between 6,000 and 900 Å using an electrodeless discharge of increasing intensity. Three groups of rays arising from Cs, CsII and states of higher ionisation were detected. Two new CsII terms were identified. H. G. C.

689. Light Excitation by Hydrogen and Deuterium Canal Rays. R. Junkelmann. *Zeits. f. Physik,* 107. 9–10. *pp.* 561–578, 1937.—The excitation of the He line 3888 Å by H and D canal rays is investigated in the range 8 to 50 kV and found to exhibit a steep rise of intensity. For the same velocity D atoms excite better than H atoms but for the same energy the inverse holds; this is in agreement with a hypothesis advanced by Döpel [see Abstract 1629 (1933)]. The excitation of Dγ and Hγ resulting from collisions of D and H atoms with He atoms in their passage through the gas is investigated; the excitation of Dγ is greater than that of Hγ both for the same velocity and the same energy. Calculation of the extinction cross-section of the 3rd Bohr orbit of the H atom in collision with He atoms gives a value 12 times greater than the gas-kinetic cross-section. The excitation of several A arc lines by H and D collisions is studied; the excitation functions pass through maxima which occur at smaller potentials and bigger velocities in the case of H excitation than for D excitation. The excitation of H_2 and D_2 by H and D is discussed. J. E. K.

690. Absorption Spectrum of Atomic Solutions of Tellurium in Sulphuric Acid. S. Boizowa and K. Butkow. *Phys. Zeits. d. Sowjetunion,* 12. 4. *pp.* 458–465, 1937. *In German.*—The absorption spectrum of atomic Te in H_2SO_4 has been examined between 2200 and 7000 Å, and the results are discussed. W. R. A.

691. Preliminary Analysis of the First Spark Spectrum of Cerium—Ce II. W. E. Albertson and G. R. Harrison. *Phys. Rev.* 52. *pp.* 1209–1215, *Dec.* 15, 1937.—By applying the spectral interval sorter and a newly designed interval recorder to new data obtained with the automatic recording spectrum comparator on the M.I.T.-W.P.A. wave-length programme, a preliminary term array for Ce II has been set up in which 584 lines have been accounted for as transitions between 31 lower and 51 upper states. The term diagram is found to be the most complex yet observed for a three-electron spectrum. Both configurations $4f5d6s$ and $4f5d^2$ appear to be low in Ce II, contrary to the analysis of Haspas. Most of the differences between observed wave numbers and those computed from the term array are less than $0{\cdot}02\ \text{cm}^{-1}$., and 60% of the lines are found to be consistent to within 0·002 Å. Several of the term assignments have been checked with partially resolved Zeeman patterns recorded by King and Albertson, and the absolute J values have been determined by this means. An inclusive description of the spectra of the Ce atom is being undertaken in the range 10,000 to 1000 Å. AUTHORS.

692. Pressure Effects of Homogeneous K Vapour in Absorption. D. S. Hughes and P. E. Lloyd. *Phys. Rev.* 52. *pp.* 1215–1220, *Dec.* 15, 1937.—By use of the newly developed corrosion-resistant MgO windows, the K resonance lines in absorption of a homogeneous vapour, were obtained for pressures ranging from 0·001 to 20 mm. Hg. The "dispersion" equation was generally adequate to describe the observed contours. The corresponding half-breadths were linear in the density, equal as between components, but of magnitude several times that predicted by the theory of the resonance interaction. The slight asymmetry which appeared at the highest pressure was attributed to van der Waals forces. But it is pointed out that, in contradistinction to the circumstance for Hg, a quantitative verification of the inverse sixth power law is probably not possible. The infra-red bands of the K_2 molecule were also observed.

AUTHORS.

693. Luminiscent-Photographic Measurement of Ultra-Violet Energy Distribution. L. N. Ananjeva and A. A. Shishlovsky. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 17. 4. *pp.* 183–187, 1937. *In English.*—The authors describe a method which uses the visible fluorescence of certain solutions for the observation of the intensity distribution of the incident u.v. light. The intensity of the fluorescent light is measured and a formula is given which connects this intensity with the relative energy distribution of the u.v. spectrum. The authors discuss the various conditions which the fluorescent solution has to fulfil in order to give satisfactory results. It is found that a thin film of sodium salicylate and gelatin on a quartz-plate satisfies these conditions. A recipe is given for the preparation of the solution. For the actual observation the film is brought into contact with an ordinary photographic plate. The fluorescence spectrum of sodium salicylate lies in the blue with a maximum at 4500 Å. This method is applicable to the region 2000–3600 Å. The authors have measured the energy distribution of the continuous H_2

spectrum and find satisfactory agreement with previous experimental results. L. K.

694. Light Absorption at the Series Limit of Line Spectra. R. W. Ditchburn. *Zeits. f. Physik*, 107. 11–12. *pp.* 719–720, 1937.—A recent theory of continuous spectra at the short wave series limit of line spectra, put forward by Bartels [see Abstract 3581 (1937)], is founded on the consideration that at the series limit no discontinuity exists in the spectral distribution of intensity. In this paper the author seeks to show that this is incorrect by showing that an apparatus with better resolving power, and greater attention to disturbing factors, indicate a definite discontinuity at this point. G. O. B.

695. Emission Spectra of Nd^{+++} Ions in Phosphors and Their Absorption Spectra in Crystals. P. C. Mukherji. *Indian Journ. Phys.* 11. *pp.* 295–304, *Dec.*, 1937.—The relation between the emission spectra of Nd^{+++} ions incorporated into colourless ground materials like K_2SO_4, CaO, etc., and the absorption spectra of the same ion in crystals is discussed. Both kinds of spectra are shown to consist of distinct groups of more or less sharp lines. A classification of the absorption spectra of Nd^{+++} ions in crystals, as carried out by the writer previously [see Abstract 4045 (1937)] is given in which electronic transitions are assigned for the separate groups of lines, one for each group. In accordance with this, electronic transitions are proposed for interpreting the groups of emission lines. The possible transitions are discussed in the light of van Vleck's theory of the absorption spectra of the rare-earth ions in solids. The phosphorescent radiations emitted are regarded as wholly quadrupole in nature and the corresponding selection rules are utilised in the assignment of transitions. The proposed transitions explain qualitatively the position of the groups, the intervals between them and their relative intensities. Some of the rare-earth ions show line fluorescence in pure condition whether in solution or in crystals; the absence of such fluorescence in the case of Nd^{+++} ions is discussed. AUTHOR.

696. Fine Structure of the Helium Line λ4686. W. Leo. *Phys. Zeits.* 38. *pp.* 920–921, *Nov.* 15, 1937. *From the Reichsanstalt.*—At about the time of its formulation Sommerfeld's theory of the fine structure of spectral lines was almost invariably regarded as being experimentally confirmed by Paschen's measurements of the fine structure of the He$^+$ line λ4686. In 1926 the author pointed out that his own measurements of λ4686 showed that those of Paschen were incorrect in as much as a line quoted by Paschen as part of the fine structure was in fact a line of a He molecular band. Subsequent measurements of λ4686 have confirmed the incorrectness of Paschen's interpretation of its structure and hence the invalidity of the Sommerfeld theory, but since there appears still to be a tendency to give credence to Paschen's interpretation the author feels it his duty once again to draw attention to the contrary evidence of all other measurements of λ4686. J. E. K.

697. Band Spectra of Halides of Hg, Cd and Zn. P. Trautteur. *N. Cimento*, 14. *pp.* 365–375, *Aug.–Sept.–Oct.*, 1937.—The spectra are photographed in the visible. A number of vibration levels are determined, and an approximate relation between dissociation energy and reduced mass is found. The dissociation energies are determined for a number of electronic states and from this it is proved, in the case of the iodides, that the ground state of the molecule dissociates into a 1 *S* state of the metal atom. R. P.

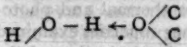
698. Emission Spectrum of $SiBr_4$. R. K. Asundi and S. M. Karim. *Indian Acad. Sci., Proc.* 6*A. pp*, 281–286, *Nov.*, 1937.—It is found that the nature of the spectrum given by $SiBr_4$ undergoes radical changes as the conditions are changed. With pressures higher than 0·5 mm. Hg the spectrum consists of a number of continuous bands. At 0·2 mm. Hg the continuous bands have practically all disappeared and a set of bands appears degraded to the violet, these latter are the SiBr bands. At 0·05 mm. Hg bands degraded to the red appear. It is suggested that some of the bands are due to $SiBr_2$ whilst others are due to SiBr or $SiBr^+$.
A. H.

699. Spectrum of the Arc in Hydrogen. R. W. Wood and G. H. Dieke. *Phys. Rev.* 53. *pp.* 146–152, *Jan.* 15, 1938.—The spectrum of an arc-like discharge in H_2 and HD of about 50 cm. pressure at a current of about 1 A was photographed with a 15 ft. grating and compared with the spectrum of the ordinary vacuum discharge. The spectrum of the arc is very different in appearance but the differences can be easily understood if one takes into account the conditions under which the arc operates. The behaviour of unclassified lines in the arc is very useful for their identification. The arc spectrum of H_2 is very similar to the spectrum obtained in the presence of an excess of He. An ordinary discharge operated at high pressures and current densities produces a spectrum which deviates from the spectrum of a discharge at low pressures and low currents in the direction of the arc spectrum. AUTHORS.

700. Infra-Red Absorption of Benzene, Chlorobenzene and Bromobenzene. M. Battista. *N. Cimento,* 14. *pp.* 343–349, *Aug.–Sept.–Oct.*, 1937.—The absorption bands are measured between 0·8 and 8 μ. In the main the results confirm those of other observers, but a number of new bands are found. It is found that the intensities of bands belonging to combination frequencies are markedly different in the three molecules. [See following Abstract.] R. P.

701. Infra-Red Absorption of Chloroform and Bromoform. A. Maione. *N. Cimento,* 14. *pp.* 361–364, *Aug.–Sept.–Oct.*, 1937.—Both substances show one absorption band at about 8 μ and one at about 6 μ which seem to be typical for these compounds. A number of other frequencies coincide with those found for aromatic compounds [see preceding Abstract] and must probably be attributed to vibrations of the C-H bond. R. P.

702. Infra-Red Spectroscopic Examination of Intermolecular Bonds. J. Errera. *Physica,* 4. *pp.* 1097–1104, *Nov.*, 1937. *In French.*—The interaction of radicals of separate molecules is investigated by the modifications of position and intensity distribution produced by their juxtaposition on their vibration-rotation bands. The spectra of water in liquid, solid and vapour states and in solution show the interaction of OH of the same molecules. Water and alcohol in active solvents show the interaction of groups in different molecules. CH does not show this interaction. The results are explained by means of bonds of the type



$\mathrm{H}\diagup\mathrm{O}-\mathrm{H}\underset{\cdot}{\leftarrow}\mathrm{O}\begin{smallmatrix}\diagup\mathrm{C}\\ \diagdown\mathrm{C}\end{smallmatrix}$

H. G. C.

703. Near Infra-Red Absorption Spectra of Amines in the Vapour and Liquid States. M. Freymann. *Comptes Rendus,* 205. *pp.* 852–854, *Nov.* 8, 1937.—Infra-red absorption spectra of amines show a displacement of the NH band towards higher frequencies in passing from the liquid to the vapour states, the vapour band in general being finer and better defined. Absorption curves for propylamine, piperidine, and pyrrol are recorded and discussed. W. R. A.

704. Near Infra-Red Absorption Spectra of Solutions of Gaseous Hydrogen Chloride in Oxygenated Organic Solvents. R. Freymann and J. Guéron. *Comptes Rendus*, 205. *pp.* 859–861, *Nov.* 8, 1937.—Infra-red absorption spectra of solutions of HCl gas in a number of oxygenated organic solvents and of the pure solvents have been examined at low temperatures. The displacements and intensities of various bands are discussed together with their bearing on the nature of the oxonium compound formed. W. R. A.

705. CH Absorption Bands of Saturated and Ethylenic Hydrocarbons between 6000 and 9500 Å. P. Barchewitz. *Comptes Rendus*, 205. *pp.* 976–978, *Nov.* 22, 1937.—The CH band of saturated hydrocarbons, observed in the third, fourth and fifth harmonics, is double. The component of shorter wave-length is attributed to CH_3 and the other to CH_2. With ethylenic compounds five components are observed. They are attributed respectively to CH_3 and CH_2 (as for saturated compounds), two to $CH_2=$, and one to $CH=$. When the double bond is not at the end of the chain, the two bands of $CH_2=$ disappear. C. B. A.

706. Absorption Bands of Hydrogels between 2·5 and 3·5 μ. A. M. Buswell, K. Krebs and W. H. Rodebush. *Am. Chem. Soc., J.* 59. *pp.* 2603–2605, *Dec.*, 1937.—Certain gels show absorption at 3 μ which appears to be proportional to their water content. Three carbohydrates examined show no absorption at 2·75 μ. A clay montmorillonite shows absorption at 2·75 and 3 μ. The height of the 3 μ band is much more strongly affected by water content than is the 2·75 μ band. A study correlating the absorption with quantitative data on water content is under way. [See also Abstract 4058 (1937).] AUTHORS.

707. Determination of Binding Moment by Infra-Red Absorption Measurements. R. Mecke. *Zeits. f. Physik*, 107. 9–10. *pp.* 595–598, 1937.—The example of water is used to show how an experimental determination of the dipole moment of a particular linkage can be based on absorption measurements in the infra-red of characteristic valence vibrations in polyatomic molecules. The bond moment of the OH-radical is found to be $1{\cdot}5 \times 10^{-18}$, in agreement with the electrical dipole measurement. C. B. A.

708. Vibration Spectra and Electric Moments of Azomethane, N—N′ Dimethylhydrazine and Acetaldazine. W. West and R. B. Killingsworth. *J. Chem. Phys.* 6. *pp.* 1–8, *Jan.*, 1938.—The investigations reported here on azomethane, $CH_3{\cdot}N = N{\cdot}CH_3$, N — N′ dimethylhydrazine $(CH_3)HN{\cdot}NH(CH_3)$, and acetaldazine $(CH_3)HC = N - N = CH(CH_3)$ were carried out primarily to obtain information on the general form and some of the structural properties of these molecules, which are of a type whose chemical behaviour with respect to thermal and photodecomposition is of considerable current interest. The properties examined have included the Raman spectra, with the state of polarisation of the stronger lines, in the liquid state, and the electric moment in solution of the three compounds; the infra-red absorption spectrum of azomethane vapour has also been investigated to the degree possible with the resolution ordinarily obtained from a rock-salt prism spectrometer. AUTHORS.

709. Infra-Red Absorption of the OH Group of Phenol. W. Gordy and A. H. Nielsen. *J. Chem. Phys.* 6. *pp.* 12–16, *Jan.*, 1938.—The fundamental vibrational band of the OH group of phenol appearing in the region of 3 μ has been studied for solutions of different concentrations of phenol in benzene, bromobenzene, nitrobenzene, dioxane, and ethyl acetate. The band appears at the same position, 2·96 μ, for the concentrated solutions in all the solvents. In dilute solution in benzene and bromobenzene it appears at 2·79 μ. The band at 2·79 μ is attributed to the OH of single molecules, while that appearing at 2·96 μ in the more concentrated solutions is thought to be due to associated OH. In dilute solutions in the oxygenated solvents the band appears at wave-lengths longer than 2·79 μ and is more intense than for the corresponding solution in benzene or bromobenzene. These results are regarded as evidence that the oxygenated solvents form weak additive compounds with the phenol by sharing the proton of the OH group. AUTHORS.

710. Infra-Red Absorption Spectrum of Phosgene. C. R. Bailey and J. B. Hale. *Phil. Mag.* 25. *pp.* 98–111, *Jan.*, 1938.—The absorption of $COCl_2$ is measured from 1 to 20μ. No band structure is found. The observed frequencies are tabulated, and an assignment of the fundamentals and overtones to the different modes of vibration is given. The force constants are calculated from the fundamental frequencies with the help of Lechner's formulæ. From a comparison with the spectra of tetrachlorethylene, urea and guanidonium chloride it is concluded that resonance between different molecular structures occurs in $COCl_2$, but that the structure which contains a $C \equiv O$ triple bond makes a more important contribution to the ground state than the structure where the double bond is placed between the C atom and one Cl atom. L. K.

711. U.V. Absorption Spectra of Aqueous Solutions of Chromic Salts. H. Sueda. *Chem. Soc., Japan, Bull.* 12. *pp.* 480–487, *Nov.*, 1937.—The u.v. absorption spectra of six solutions of chromic chloride and sulphate hydrates were quantitatively measured. Violet chromic sulphate and chrome alum should respectively have the formula $[Cr(H_2O)_6]_2\ (SO_4)_3$ and $K[Cr(H_2O)_6]\ (SO_4)_2$. Chloro-aquo chromic salts were transformed into the hydroxopentaquo chromic salts in the solutions where the pH-values were higher than 4·0. The substitution of a Cl atom for a molecule of water in these salts caused the absorption band to shift in the direction of the increasing wave-length and absorption capacity. Following his method, the author has made a comparison of calculated and observed values of the absorption of green chromic chloride. AUTHOR.

712. Absorption Spectrum and Photodecomposition of $KMnO_4$. A. L. S. Rao. *Indian Acad. Sci., Proc.* 6*A*. *pp.* 293–300, *Nov.*, 1937.—In view of the discrepancies between the results obtained by different workers and because of the apparent variation in position of some of the bands under different conditions the absorption spectrum and photodecomposition in monochromatic light of $KMnO_4$ are investigated. The absorption spectrum is found to consist of three distinct regions, and one new band is found whilst the existence of another previously reported is denied. As regards the photo-dissociation it appears that there are no strongly selective wave-lengths. Further work on the quantum yield is in progress. A. H.

713. Absorption Spectra of Azo-Compounds. A. Burawoy. *Chem. Soc., J. pp.* 1865–1869, *Dec.*, 1937.—It has been shown in previous communications of this series [see *Ber.*, 66. *p.* 228, 1933] that there appear between 2000 and 8000 Å two different types of absorption band due to two different types of chromophore : (i) bands of very low intensity ($\epsilon < 2000$) due to multiple linkages (R-bands, R-chromophores) ; (ii) bands of high intensity ($\epsilon > 5000$) due to conjugated systems (K-bands, K-chromophores). These two types of absorption band also obey very different optical laws. In the present paper the absorption spectra of numerous azo-compounds are reported, with a view to testing the validity of the classification previously given. The previous results are confirmed. AUTHOR.

714. Band Spectra of PbSe, SnSe and PbTe in Absorption. J. W. Walker, J. W. Straley and A. W. Smith. *Phys. Rev.* 53. *pp.* 140–145, *Jan.* 15, 1938.—A vibrational analysis has been made of band systems in the visible region due to PbSe, to SnSe and to PbTe. These bands were observed in absorption. In each case the band heads degrade toward the red. The vibrational coefficients ω_e and $\chi_e\omega_e$ for the ground state and for the first excited state are compared with those of the band systems in PbO, SnO, PbS and SnS. The expected trend in these vibrational constants is observed in each case, namely a decrease in ν_h, ω_e and $\chi_e\omega_e$ with increasing number of electrons in the molecule. AUTHORS.

715. Rôle of Argon in the Production of Swan Bands. N. R. Tawde and D. D. Desai. *Indian Acad. Sci., Proc.* 6*A*. *pp.* 266–280, *Nov.*, 1937.—The distribution of intensity among the lines of a spectrum in a discharge tube is affected by, among other factors, the presence of a foreign gas. In order to follow the effect of A on the isolation of the C_2 Swan system a study was made of the changes which take place in the system on the gradual addition of A at pressures of 10, 15, 20, 25 and 30 mm., using the H-type tube having one C and one Al electrode. Full data for photographic intensities, I/ν^4 values, transition probabilities, positions of intensity centres and effective temperatures are tabulated, and a provisional explanation of the general results is discussed. N. M. B.

716. Possible Interpretation of the Bands of Ozone. L. Herman and Herman-Montagne. *Comptes Rendus*, 205. *pp.* 1056–1057, *Nov.* 29, 1937.—Utilising the fact demonstrated by London that the potential energy of symmetrical triatomic molecules is a linear function of the energies of the constituents, the spectrum of O_3 has been interpreted. Recorded bands are discussed and it is concluded that the analogies in the spectra of O_2, of O_3, and of $(O_2)_2$ arise from the fact that the three polymers include the same electronic levels. W. R. A.

717. Interpretation of the Electron Spectra of Polyatomic Molecules. Part I. Franck-Condon Principle. F. Duschinsky. *Acta Physicochimica*, 7. 4. *pp.* 551–566, 1937. *In German.*—The possible changes of normal coordinates and characteristic vectors for an electron transition in a polyatomic molecule are discussed and for the most general possible change intensity rules for antisymmetrical oscillations are discussed in generalisation of a calculation of Herzberg and Teller. The concept of " combination transitions " is discussed and a simple intensity rule derived. A simplified graphical representation of the Franck-Condon principle is described. J. E. K.

718. Molecular Vibrations in Deuterium Compounds. E. Bartholomé. *Zeits. f. Elektrochem.* 44. *pp.* 15–20 ; *Disc.*, 20–21, *Jan.*, 1938.—The derivation of a model of a polyatomic molecule which affords complete correspondence between observed infra-red and Raman frequencies and the expected modes of vibration of the atoms is a necessary preliminary to the statistical calculation of the thermodynamic properties of the molecule. In the case of normal polyatomic molecules the contribution of vibrational energy amounts only to a small correction term in the thermodynamic equation of a reaction but in the case of reactions between isotopic polyatomic molecules it becomes the predominant factor and its determination is therefore of the utmost thermodynamic importance. An account is given of the new lines of approach to the determination of polyatomic molecular models arising out of the spectroscopy of isotopic modifications; this account is illustrated throughout with reference to molecules isotopic in respect to the H atom(s), *i.e.*, molecules in which the atoms of the H may be wholly or partially substituted by D atoms. It is first indicated how the change or absence of change in the spectrum arising from substitution of H by D atoms can afford qualitative information concerning the correlation of observed preferences and modes of vibration. The assistance to correlation afforded by the product rule of Teller and Redlich is next discussed with special reference to determinations of the structure of C_6H_6 by Angus and others [see Abstracts 3931 to 3938 (1936)], ND_3 by Barker and others [see Abstract 4717 (1936)] and H_2O by the author. Finally the application of the isotope effect to determination of the force constants of a polyatomic molecule is discussed with particular reference to the CH_4 molecule. J. E. K.

719. Anomalous Vibrational Spectra. M. Blackman. *Roy. Soc., Proc.* 164*A. pp.* 62–79, *Jan.* 7, 1938.—The equation of motion of an elastic continuum is investigated, and it is shown that the continuum becomes unstable when the elastic constants obey certain relations. The vibrational spectrum of lattices for which these relations hold is shown to undergo a characteristic change, the density of normal vibrations going over into the one-dimensional or into the two-dimensional form. The significance of this is considered from the point of view of the specific heat and the vibrational spectrum of actual crystals; it is found that no actual crystals are near enough to the critical regions for the effect of the approach to be apparent in the specific heat, but in some cases this should be noticeable in the vibrational spectrum. AUTHOR.

720. Potential Energy Curve of the Excited State of LiH. E. J. Rosenbaum. *J. Chem. Phys.* 6. *pp.* 16–18, *Jan.*, 1938.—A method developed by Klein [see Abstract 3763 (1932)] has been applied to obtain the potential energy curve of the excited electronic state of LiH (state *V*). This curve crosses the Coulombic curve of Li^+H^- and indicates dissociation of excited LiH into Li(^{2}P) + H. The effect of this behaviour on Mulliken's explanation of the unusual shape of the state *V* curve is discussed. The interaction of the Li^+H^- and Li(^{2}P)·H curves at moderately large interatomic distances is larger than Mulliken's estimate. AUTHOR.

***721. Method for Study of Hyperfine Structure and Width of Absorption Rays. M. Duffieux and J. Bollot.** *Comptes Rendus,* 205. *pp.* 1227–1229, *Dec.* 13, 1937.—If $\Delta_1\lambda$ is the separation between orders of an interferometer and $\delta_1\lambda$ is the smallest interval resolved, then the value $\dfrac{\Delta_1\lambda}{\delta_1\lambda}$ (10–25 generally) limits the usefulness of the interferometer for the study of hyperfine structure and makes its use impossible in the case of absorption rays. The disadvantage is overcome by introducing a second interferometer to produce fringes separated by $\delta_2\lambda$ and $\Delta_1\lambda$. The spectrograph with which the system is crossed must have a resolving

power equal to $\Delta_2\lambda$. An apparatus composed of a plane Rowland grating, an étalon of varying separation and an échelon grating is described.
H. G. C.

722. Hyperfine Structure and Nuclear Moments of Aluminium. D. A. Jackson and H. Kuhn. *Roy. Soc., Proc.* 164*A. pp.* 48–61, *Jan.* 7, 1938.—The hyperfine structure of the resonance lines of Al was investigated by means of the absorption in an atomic beam of Al. The line $3^2P_{\frac{1}{2}}-4S_{\frac{1}{2}}$ was found to possess three components at $-0\cdot048$, $0\cdot000$ and $+0\cdot048$ cm.$^{-1}$ of nearly equal intensity. The line $3^2P_{\frac{1}{2}}-3^2D_{\frac{3}{2}}$ possessed two components of separation $0\cdot066$ cm.$^{-1}$, the intensity ratio of which was measured to a high degree of accuracy; the value found was $1\cdot21 : 1$, the component of longer wave-length being the stronger. From the structure of the line $3^2P_{\frac{1}{2}}-4S_{\frac{1}{2}}$ it follows that the levels $4S_{\frac{1}{2}}$ and $3^2P_{\frac{1}{2}}$ are both split into two levels, of separation $0\cdot048$ cm.$^{-1}$ (the greater splitting of the line $3^2P_{\frac{1}{2}}-3^2D_{\frac{3}{2}}$ is due to a small unresolved, inverted structure of the level $3^2D_{\frac{3}{2}}$ which is probably caused by perturbation by the term $3s\ 3p^2\ {}^2D_{\frac{3}{2}}$). The observed intensity ratio of the components of the line $3^2P_{\frac{1}{2}}-3^2D_{\frac{3}{2}}$ gives a value $\frac{9}{2}$ for the nuclear spin, and the splittings of the levels $4S_{\frac{1}{2}}$ and $3^2P_{\frac{1}{2}}$ give values $4\cdot1$ and $3\cdot6$ nuclear magnetons respectively for the magnetic moment of the nucleus according to the formulæ of Goudsmit. The lines $4S_{\frac{1}{2}}-5^2P_{\frac{3}{2}}$ and $4S_{\frac{1}{2}}-5^2P_{\frac{1}{2}}$ were observed in emission and were found to be doublets, only just resolvable on account of their Doppler width, of separation about $0\cdot05$ cm.$^{-1}$ and of intensity ratio (when corrected for overlapping) about $1\cdot23 : 1$, the component of longer wave-length being the stronger. This structure is in complete agreement with the interpretation of that observed in the resonance lines. This result is in disagreement with the contents of a preliminary note by Ritschl in which, from an observed doublet structure of the arc lines 3057 and 3050 and the spark line 2669, he suggested a nuclear spin of $\frac{1}{2}$; an investigation of the structure of these lines showed that the observed doublet structures do not represent a complete resolution. AUTHORS.

723. Mechanical Moment of the Sr^{87} Nucleus and the Radioactivity of Rb^{87}. M. Heyden and H. Kopfermann. *Zeits. f. techn. Physik*, 18. 12. *pp.* 534–535, 1937. *Phys. Zeits.* 38. *pp.* 960–961, *Dec.* 1, 1937.—Investigation of the hyperfine structure of Sr by Schüler and Westmeyer indicated a probable value of $I = 3/2$ for the nuclear moment of the rare isotope Sr^{87}. The authors have been able to procure and investigate the hyperfine structure of a sample of pure Sr^{87}. and establish the true value of the nuclear moment as $I = 9/2$. Comparison of this value with the moment $I = 3/2$ of Rb^{87} shows that in the radioactive process $Rb^{87} \rightarrow Sr^{87}$ a large change in nuclear spin, $\Delta I = 3$, takes place as expected on the basis of the β-disintegration theory. At the same time the magnetic nuclear moment changes from $+2\cdot6$ nuclear magnetons in the case of Rb^{87} to the value $-1\cdot1$ nuclear magnetons in the case of Sr^{87}.
J. E. K.

724. Influence of the Magnetic Field on the Fluorescence of Mercury Vapour and Zeeman Effect in Band Spectra of Loosely-Bound Molecules. S. Mrozowski. *Acta Physica Polonica,* 6. 3. *pp.* 201–209, 1937. *In German.*—The green fluorescence of Hg is excited by the line 2537 Å, and the intensity distribution of the fluorescence is investigated as a function of the magnetic field. It is shown that the maxima and minima of the intensity which occur for certain magnetic forces, are independent of the structure of the exciting radiation. It is concluded from these results that the loosely bound Hg_2 molecules and not the atoms are excited directly by absorption, and an explanation of the whole effect is given. The Zeeman-effect in band spectra of loosely bound molecules is discussed. L. K.

725. δ (CH) Vibration in Sodium Formate. J. Gupta. *Indian Journ. Phys.* 11. *pp.* 333–335, *Dec.*, 1937.—The composite character of the Raman line 1398 cm^{-1}. of formic acid is discussed, in contrast with the line 1353 cm^{-1}. of sodium formate, from points of view of nature, intensity and polarisation characters. Spectrograms are reproduced to show that the 1398 line of formic acid is replaced by a pair of lines, 1355 and 1395, of different intensities, in the crystals of sodium formate. The feeble intensity of the line 1395, which is identified with the δ (CH) vibration of the formate ion, is in accord with the intensity of the corresponding line in other organic molecules where a single H atom is attached to C.
AUTHOR.

726. Intensities of Raman Lines Due to Lattice Oscillations. S. C. Sirkar. *Indian Journ. Phys.* 11. *pp.* 343–348, *Dec.*, 1937.—It is pointed out that the results of investigation of the Raman spectra of ammonium halides at different temperatures by Menzies and Mills [see Abstract 1169 (1935)] definitely show that the Raman line due to lattice oscillation cannot have any appreciable intensity when the arrangement of the kations on opposite sides of an anion is symmetric. The arrangement of the molecules in the crystals of naphthalene, *p*-dichlorobenzene and *p*-dibromobenzene is discussed and it is shown that in these cases and especially in the case of naphthalene there cannot be any asymmetry in the arrangement of the two molecules on opposite sides of any particular molecule, and therefore the Raman line due to lattice oscillation cannot have any appreciable intensity in these cases. The Raman spectra of these crystals are reproduced to show the large intensities of the new lines close to the Rayleigh line relative to those of the other Raman lines. The above facts lead to the conclusion that the new Raman lines are due to oscillations in a polymerised group as suggested previously. AUTHOR.

727. Polarisation of Raman Lines of Pyrrol, Furane and Thiophene. A. W. Reitz. *Zeits. f. phys. Chem.* 38. *Abt.B.* 4. *pp.* 275–291, 1937.—The method used for determining the depolarisation factors ρ of the Raman lines was first tested by making measurements on 17 plates bearing Raman spectra of CCl_4, and the deviation of the values of ρ for individual plates from the mean was found to be 8%. The values of ρ were then found for practically all the Raman lines of pyrrol, furane, and thiophene. Pyrrol had five clearly polarised lines in the frequency region less than 1700 cm^{-1}., and the other two substances six each. Comparison of the observations with those to be expected from symmetry considerations suggested the point-group C_{2v} for all three substances. A. C. M.

728. Raman Spectra of Diacylamines. B. V. Thosar. *Zeits. f. Physik*, 107. 11–12. *pp.* 780–784, 1937.—The Raman spectra of di-iso-butylamine, di-n-propyl- and di-iso-propylamine, diamyl- and diallylamine were investigated. It is shown that the Raman shifts in the spectrum of a di-iso-amine are frequently different from those of the corresponding normal diamine. Diallylamine shows interesting deviations on account of the existing double binding. A widened diffuse band at 2920 cm^{-1}. is probably due to CH oscillation, by which the oscillating C atom is joined to three other C atoms. The Raman frequencies of a diacylamine molecule differ frequently from those of a corresponding monoacylamine. J. J. S.

729. Raman Spectra of Benzene and Isotope Effect. H. C. Cheng, C. F. Hsueh and Ta-You Wu. *J. Chem. Phys.* 6. *pp.* 8–11, *Jan.*, 1938.—A faint line accompanying the strong line in the region of 990 cm^{-1}. is observed in the Raman spectra of benzene, chlorobenzene, bromobenzene, toluene and cyclohexane. The relative intensities of the weak 984 cm^{-1}. line and the strong 992 cm^{-1}. line of benzene are measured to be in the ratio 6 : 100. This, together with an approximate theoretical estimate, supports the suggestion that the weak line is due to molecules in which one of the C atoms is an isotope of mass 13. The exceedingly low intensity of the corresponding faint line in cyclohexane seems to point to a nonplanar structure. Similar study on the 944 cm^{-1}. line in C_6D_6 is suggested. AUTHORS.

730. Additional Raman Frequencies for Water. I. R. Rao and P. Koteswaram. *Phil. Mag.* 25. *pp.* 90–98, *Jan.*, 1938.—A number of workers have reported the following Raman frequencies for water :—60, 175, 500, 700, 1650, 2150, 3200, 3400, 3600, 4023, and 5100. A critical study of the intensity and frequency values of the Raman bands of water in both the visible and u.v. regions of the spectrum, reveals that all these are not bands of different Raman frequencies excited by the same Hg line, but correspond to the same principal Raman band of water of frequency 3200–3600 arising out of different strong lines of the Hg arc, the excitation by which was ignored by them. The only genuine frequency other than this is at 1650, which happens to be the other fundamental for water. AUTHORS.

***731. Large Aperture Spectrographs Constructed at The Optical Institute, Leningrad. G. Sljusarev and V. Chernjajev.** *Techn. Phys., U.S.S.R.* 4. 9. *pp.* 742–751, 1937. *In French.*—The construction of glass spectrographs of 1 and 0·58 apertures and a quartz spectrograph of aperture 1 is described. The objectives of two of them consist of three aplanatic meniscus lenses and one concave convex lens of minimum spherical aberration. The objective of the other is of the microscope type. The dispersions of the spectroscope are small but their definition is good. Photographs of the night sky and of Cd and Hg are given. H. G. C.

***732. Photoelectric Transmission Spectrophotometer for the Measurement of Photosensitive Solutions. S. Shlaer.** *J.O.S.A.* 28. *pp.* 18–22, *Jan.*, 1938.—This spectrophotometer was designed specifically to measure in the visible region the absorption spectrum of visual purple, the photosensitive substance of the retinal rods. It is independent of both the photo-cell and amplifier characteristics, relying only on the law of crossed polarising prisms. The sensitivity of the detecting system is high enough so that the measuring light produces no detectable effect upon the measured solution. The entire system can measure a transmission of 1% to a precision of about 1%. AUTHOR.

***733. New Infra-Red Spectrograph with a Novel Method for Registering the Heat Radiation. E. Lehrer.** *Zeits. f. techn. Physik*, 18. 11. *pp.* 393–396, 1937.—Spectra are recorded by an alternating light method with a bolometer as receiver of radiation and a three-stage resonance amplifier. The records are traced by a bolometer amplifier and an inking pen. Details of the arrangement and reproductions of tracings are given and discussed. W. R. A.

734. Simplifications and Improvements in Spectrophotometry with Auxiliary Light Source. G. Bolla. *N. Cimento*, 14. *pp.* 350–360, *Aug.–Sept.–Oct.*, 1937.—If, for the purpose of producing intensity marks,

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a " V " shaped slit is used instead of a number of different marks, intensities may be read from the microphotometer record, and there is no need to construct a blackening curve and interpolate from it. A number of improvements are also discussed. R. P.

735. New Method of Obtaining the Spectra of Metals. H. Muraour and A. Michel-Lévy. *Comptes Rendus*, 205. *pp*. 1054–1055, *Nov*. 29, 1937.—By a modification of the previous experimental arrangement [see Abstract 5032 (1937)] the spectra of metals have been obtained by placing the metal, in the form of thin foil (0·02 mm. thick) attached to a brass block by means of vaseline, in an atmosphere of argon and allowing it to come in contact with a powerful explosion wave. The spectrum of Al is reproduced and appears to be identical with that obtained from a thin thread of Al evaporated by means of a strong condenser discharge. W. R. A.

736. Infra-Red Spectrum and Structure of Silicates and Glasses. F. Matossi. *Zeits. f. techn. Physik*, 18. 12. *pp*. 585–588, 1937. *Phys. Zeits*. 38. *pp*. 1011–1014, *Dec*. 1, 1937.—The infra-red reflection spectra of glasses were studied and found to be similar to those of crystalline silicates. The exact position of the characteristic maximum in the region of 9·5 μ was found to depend upon the composition of the glass. Observations on quartz-glasses support the theory that glass is composed of an irregular assemblage of crystallites. D. H. F.

See also Abstracts 391, 399, 644, 672, 680, 784, 820.

TRANSMISSION.

737. Transmission of an Invisible Radiation through Various Chemical Solutions as Recorded by the Infra-Red Plate. L. C. Massopust. *Radiology*, 29. *pp*. 551–555, *Nov*., 1937.—Ordinary light shows the existence of an invisble radiation, in the infra-red region, which is transmitted through various chemical solutions at a greater velocity than through air. Filtering visible light from the spectrum does not alter the photographic action of this radiation. A 1% solution of various copper salts absorbs the radiation but these are the only metallic salt solutions, which, up to the present, have been found to absorb the radiation. Atomic weight and molecular density of a solution apparently have no effect on the transmission of this invisible radiation, which appears to be confined to a rather narrow band in the infra-red region. The author describes in detail his methods of investigating the transmission of this radiation. B. J. L.

738. Transmission of Zinc Blende and of the Copper and Cadmium Halides in the Far Infra-Red. M. Parodi. *Comptes Rendus*, 205. *pp*. 1224–1226, *Dec*. 13, 1937.—Using the method of residual rays, the absorption of the following compounds was measured, in each case the presence of a single fundamental band being established : ZnS, CuCl, CuBr, CuI, $CdCl_2$, $CdBr_2$. The observed wave-length of the band for ZnS was compared with the wave-length calculated from Born's theory and good agreement was obtained. Other comparisons were also made with the formulæ of Madelung and Lindemann and gave satisfactory agreement. W. S. S.

See also Abstract 481.

VISION.

739. Critical Illumination and Flicker Frequency in Related Fishes. W. J. Crozier, E. Wolf and G. Zerrahn-Wolf. *J. Gen. Physiol.* 21. *pp.* 17–56, *Sept.* 20, 1937.—Measurements have been made of the reaction of fishes to a series of stripes moving past the fish at various speeds. An equation expressing the relation between critical frequency and illumination has been derived. The paper discusses the types of flicker recognition curves found in various species and the variation of the curves introduced as the result of crossing. The operation of the rod and cone mechanisms are also differentiated. [See following Abstract.]
W. D. W.

740. Intensity and Critical Frequency for Visual Flicker. W. J. Crozier, E. Wolf and G. Zerrahn-Wolf. *J. Gen. Physiol.* 21. *pp.* 203–221, *Nov.* 20, 1937.—Using the rotating striped cylinder device previously employed for determination of the flicker response function with lower animals, corresponding measurements have been made with human observers. The curves based upon the relation between critical flash frequency and critical intensity for the signalling of the recognition of flicker have the properties of human flicker fusion data as obtained by other methods. They also have the quantitative properties of the flicker curves provided by the motor responses of insects and fishes. The data for human visual flicker and those for the responses of lower animals are therefore essentially homologous. [See preceding Abstract.] W. D. W.

741. Visual Adaptation and Chemistry of the Rods. G. Wald and A. B. Clark. *J. Gen. Physiol.* 21. *pp.* 93–105, *Sept.* 20, 1937.—The reality of a chemical cycle proposed to describe the rhodopsin system is tested with dark adaptation measurements. The first few minutes of rod dark adaptation are rapid following short periods of light adaptation, slow following long periods. As dark adaptation proceeds, the slow process grows more prominent, and occupies completely the final stages of adaptation. Light adaptation displays similar duality. As the exposure to light of constant intensity lengthens, the visual threshold rises, and independently the speed of dark adaptation decreases. These results are said to conform with predictions from the chemical equations. All the observations refer to a point on the retina situated about 10° from the fovea. W. D. W.

***742. Relation between Visual Acuity and Illumination. S. Shlaer.** *J. Gen. Physiol.* 21. *pp.* 165–188, *Nov.* 20, 1937.—An apparatus for measuring the visual acuity of the eye at different illuminations is described. The test object is continuously variable in size and is presented at a fixed distance from the eye in the centre of a 30° field. Observation of the field is through an artificial pupil. Means for varying the intensity over a range of $1 : 10^{10}$ in small steps is provided. A broken circle and a grating were used as test objects. The measurements with both test objects show a break at a visual acuity of 0·16, all values below that being mediated by the rods and those above by the cones. It is shown that the limiting factor in the resolution of the grating is the diameter of the pupil when it is less than 2·3 mm. and the size of the central cones when the pupil is larger than that. The data are discussed in terms of Hecht's photochemical theories. W. D. W.

743. Visual Acuity. K. U. Smith. *Science,* 86. *pp.* 564–565, *Dec.* 17, 1937.—Experiments are described which suggest that the current theory

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concerning the central neural basis of visual acuity must be modified. The experiments prove that only under limited conditions does the abolition of the cortical centres of vision bring about a reduction in visual acuity. A. H.

744. Effect of Temperature on the Photochemical Bleaching of Visual Purple Solutions. H. J. A. Dartnall, C. F. Goodeve and R. J. Lythgoe. *Roy. Soc., Proc.* 164*A*. *pp.* 216–230, *Jan.* 21, 1938.—The theoretical considerations developed previously for the photochemical bleaching of a light absorbing substance have been extended to include the case where the products absorb light. 25 out of 29 experiments with visual purple were found to be in accordance with these and the previous considerations. In the remaining four, the decomposition of a coloured product, " transient orange," proceeded at a rate comparable with the rate of bleaching of visual purple. The quantum efficiency of the bleaching process was found to be independent of temperature over the range, 20–60°, and of pH from 6·8 to 9·2. It is concluded that the quantum efficiency is equal to or not much less than unity, and that the molar extinction coefficient $(\lambda = 506 m\mu)$ is $2 \cdot 3 \times 10^4$. [See also Abstract 3706 (1936).] AUTHORS.

See also Abstract 544.

X-RAYS.

***745. X-Rays from Radio Valves. H. D. Simons, G. L. Clark and O. C. Klein.** *Radiology*, 29. *pp.* 721–723, *Dec.*, 1937.—X-rays can be produced by radio apparatus using high frequencies built at a negligible cost as compared to standard X-ray apparatus. A radio apparatus of this type is briefly described and photographic illustrations given of radiographs produced at a distance of several feet from the apparatus, the total weight of which is 28 lbs. B. J. L.

746. Simultaneous Reflection of X-Rays and Indirect Excitation. M. Blanc and J. Weigle. *Helv. Phys. Acta*, 10. 6. *pp.* 495–506, 1937. *In French.*—Simultaneous reflection by several planes in a crystal has been recently studied, and the existence of a phenomenon, called by Ewald indirect excitation, established. It is shown theoretically that a reflecting plane of which the structure factor is zero can apparently reflect X-rays while there is simultaneous reflection from another plane. The magnitude of the region of reflection is studied for a particular case, and it is proved that the " additional " ray is of the order of magnitude of the rays formed by simple reflection, a magnitude which is independent of the properties of the crystal. The intensity of the additional ray depends on the relative values of the structure factors for the planes playing a part in the phenomenon. It has not been found possible to give an explicit expression for its value. Although the structure factor of the plane considered is nil, the intensity of the additional ray can be as large as if the reflection had taken place at one of the planes taking part in the phenomenon. These additional rays for planes of structure factor 0 have been studied experimentally by Renninger. C. J. B. C.

747. Further Study of X-Ray Diffraction in Quartz. G. W. Fox and J. R. Frederick. *Phys. Rev.* 53. *pp.* 135–136, *Jan.* 15, 1938.—The X-ray energies in the central beam and in the $K\alpha_1$ and $K\beta_1$ lines of Ag have been examined after passing through X, Y and A cut quartz plates non-oscillating and oscillating piezoelectrically. No difference in the intensity of the central beam or in the intensities of the Ag lines could be observed whether or not the absorbing crystal was oscillating. [See also Abstract 3083 (1935).] AUTHORS.

***748. Collodion Filter for Kα Chromium Radiation. S. S. Sidhu.** *Indian Journ. Phys.* 11. *pp.* 337–338, *Dec.*, 1937.—Collodion filters of ammonium (meta) vanadate have been found very satisfactory for obtaining Kα Cr radiation. This note describes the method of preparation, the concentration of V which proved most suitable, and the satisfactory condition of operation of an X-ray tube in conjunction with such filters. AUTHOR.

749. Soft X-Ray Bands from Dilute Alloys. H. W. B. Skinner and J. E. Johnston. *Cambridge Phil. Soc., Proc.* 34. *pp.* 109–114, *Jan.*, 1938.—It is shown that the soft X-ray emission bands from Be and Al, present in small quantities in solid solution in Cu and Al, have a form without a sharp high-energy edge, the feature most characteristic of these bands in pure metals. The diffuse form of the bands indicates (1) that all the valence electrons of the impurity atom are given up to the lattice, (2) that the impurity atom refuses to take within it those electrons of the lattice which have energies close to the maximum energy of the conduction electrons. AUTHORS.

750. Resolving Power in X-Ray Spectra. V. Dolejšek and M. Tayerle. *Comptes Rendus*, 205. *pp.* 1143–1145, *Dec.* 6, 1937.—High resolving power can be obtained with the curved crystal grating if the curvature is adjusted so that the reflected rays form a parallel beam. Values of $\lambda/d\lambda$ up to 5700 are recorded using gypsum gratings. C. B. A.

***751. Curved Quartz Crystal X-Ray Spectrograph and Determination of Grating Constant of Quartz. B. B. Watson.** *Rev. Sci. Instruments*, 8. *pp.* 480–485, *Dec.*, 1937.—The construction of a small experimental spectrograph of the curved crystal type is described. The use of quartz, instead of mica or gypsum which are customarily used, and the improvement of the spectra thus obtained are discussed. The theory of the curved crystal X-ray spectrograph has been extended in two ways: (1) to cover the doubling of spectral lines which arises due to reflections from opposite surfaces of the crystal, and (2) to cover the vertical separation of spectral lines produced by reflections from opposite sides of atomic reflecting planes. This latter effect is traced to a nonparallelism between the reflecting planes and the axis of curvature of the crystal. By means of the curved crystal spectrograph the grating constant for the basal planes of quartz was determined. This value was found to be $d = 5{\cdot}393 \pm 0{\cdot}002$ Å. AUTHOR.

752. Validity of the Bunsen-Roscoe Law for the Photographic Action of X-Rays of Long Wave-Length. E. Mülbach. *Zeits. f. wiss. Phot.* 36. *pp.* 269–282, *Dec.*, 1937.—Gives the results of an experimental examination of the problem, it being found that for the Ag Lα_1 and W Mα_1 lines, the photographic action satisfies the Bunsen-Roscoe reciprocity law, and the Schwarzschild constant has a value of unity. For the wave-lengths examined, 4·146 and 6·969 Å respectively, no threshold value of the blackening exists, and the shape of the blackening curves is found to become nearer to those for visible radiations with increasing values of wave-length. R. C. F.

See also Abstracts 888, 889, 894 and

331B. Small X-Ray Apparatus for Diffraction Work. Bourek.
466B. Production of Super-Voltage X-Rays by Means of an Electrostatic Generator. R. Dresser, J. Trump and R. J. van de Graaff.
467B. Dosage Measurements on Ten 400-kV X-Ray Generators. O. Glasser

HEAT.

CALORIMETRY.

*753. **Comparison of Specific Heats of Gases at Temperatures above the Surrounding Temperature. A. Potop.** _Comptes Rendus_, 205. _pp._ 1047–1049, _Nov._ 29, 1937.—In a method proposed by Blackett, Henry and Rideal for the determination of the specific heat of gases, a stream of gas is caused to flow in the annular space between an axial heated metallic tube and a surrounding jacket [see Abstract 2234 (1930)]. Particulars are given of an apparatus designed by the author for determinations above 370° C., and difficulties encountered when experimenting at 600° C. are stated. Hitherto, owing to a state of dissymmetry of temperature distribution in the absence of gas flow, it has not been possible to obtain reliable results with the apparatus. J. S. G. T.

754. Low-Temperature Heat Capacity of Gaseous Ethane. G. B. Kistiakowsky and F. Nazmi. _J. Chem. Phys._ 6. _pp._ 18–24, _Jan._, 1938.—The heat capacity of ethane has been determined at 163° and 143° K. by the " hot wire " method and has been found not to level off as suggested earlier by Eucken and Weigert [see Abstract 242 (1934)]. This speaks against free internal rotation in ethane molecules. AUTHORS.

755. Heat Capacity of Supercooled Liquid Glycerol. A. G. Oblad and R. F. Newton. _Am. Chem. Soc._, _J._ 59. _pp._ 2495–2499, _Dec._, 1937.—The heat capacity of glycerol has been measured by the method of mixtures, in such a way as to ensure time for the establishment of equilibrium with respect to all forms of thermal energy of the molecules. These measurements are in disagreement with those obtained by the Nernst method for temperatures below 190° K. A nearly constant heat capacity has been found in the region in which the Nernst method gives a rapidly changing one, and a plot of these heat capacities is apparently a prolongation of the curve obtained by the Nernst method above 190° K. In the neighbourhood of 175° K. about a week is required to establish complete equilibrium, and presumably at lower temperatures much greater periods will be required. The long times required indicate that some of the forms of thermal energy in very stiff glasses are attained much too slowly to be measured by the Nernst method, and that conclusions relative to the applicability of the third law of thermodynamics to glasses cannot be based upon measurements by the Nernst method. AUTHORS.

*756. **Semi-Microcalorimeter for Heat Capacities at Low Temperatures. D. R. Stull.** _Am. Chem. Soc._, J. 59. _pp._ 2726–2733, _Dec._, 1937.—The construction and operation of a calorimeter suitable for determining specific heats together with heats of transition and fusion of organic compounds over the temperature range 100 to 320° K. is described. The apparatus possesses the advantage of not employing a vacuum, and requiring only a 5- or 6-ml. sample. The following compounds have been measured by this method ; toluene, CCl_4, fluorobenzene, chlorobenzene, bromobenzene, iodobenzene, and the five isomeric hexanes. Two anomalies were brought to light. The specific heat of _n_-hexane showed a "hump" in the liquid state. The solid state of 2,2-dimethylbutane showed a large heat of transition some 50° below its melting point. AUTHOR.

*757. **Microcalorimeter-Thermostat for Heat Development of Radioactive Minerals. N. v. Szentpály.** _Akad. Wiss. Wien_, _Ber._ 146. 2_a_. 3–4. _pp._ 223–247, 1937.—A microcalorimeter is described of 2 cm. dia.

which, with 46 Cu-constantan thermo-pairs and a heat spiral arranged in a brass vessel of 6 cm. dia., is so fixed that the remaining 46 thermo-pair ends attached to the inner wall of the brass vessel make it possible to determine a temperature difference of about 8×10^{-5} ° C. per mm. throw on the optical scale. The apparatus is enclosed in an electrically heated three-walled copper thermostat. The temperature can be kept constant to within about 10^{-5} °C. The measurements on radioactive minerals yielded an additive development of heat for gases only; otherwise the theoretical values were confirmed. The additive heat development found by other investigators may be imputed to adsorption phenomena. J. J. S.

758. Calorimetric Measurements on Refrigerants. A. Perlick. *Zeits. f. ges. Kälte-Ind.* 44. *pp.* 201–206, *Nov.*, 1937.—A vacuum calorimeter constructed of Cu has been used to determine calorimetric data at low temperatures for sulphur dioxide, methylene chloride, difluor-monochlorethane and tetra-fluor-di-chlorethane. R. W. P.

See also Abstracts 438, 763, 764, 765.

CONDUCTION.

759. Heat Conduction of Foil-Covered Insulation. I. S. Cammerer. *Wärme*, 60. *pp.* 765–767, *Nov.* 20, 1937.—The paper deals with the method of measuring the effective thermal conductivities of insulating materials, in which a heat-flux device is placed over a portion of the surface. Diagrams are reproduced showing the manner in which this procedure disturbs the heat flow lines within the insulation, and the extent to which the disturbance is increased when the insulation is encased in metal. With metal foils 0·5 mm. thick, the 25 cm. wide side guards normally employed to overcome this source of error are quite inadequate, errors ranging from + 40 to − 20% being observed for a typical sample according as the foil has a low or high emissivity. To avoid these errors it is recommended that the specimen should be covered with thin paper to a width of 3 to 4 m. before applying the flux meter and the normal guards. R. W. P.

760. Thermal Conductivity of Diamond and Potassium Chloride. W. J. de Haas and T. Biermasz. *K. Onnes Lab. Leiden, Comm. No.* 251*a*. *Physica*, 5. *pp.* 47–53, *Jan.*, 1938. *In English.*—In continuation of previous work [see Abstract 4103 (1937)] the authors have determined the thermal conductivity of rods of KCl of various dimensions at temperatures 2·47°–81·8° K. The results show that the thermal resistivity of the rods depends on their dimensions. The assumption that the increase of thermal resistance of the rods at the temperature of liquid He is due exclusively to reflection of elastic waves at the crystal boundaries is found to be untenable in the case of the thicker rods. The thermal conductivity of diamond is investigated at 89·4–2·99° K. The value shows an increase proportional to $T^{-2.5}$ with decrease of temperature, and the increase is clearly seen to commence in the liquid H_2 region of temperature. J. S. G. T.

See also Abstract 794.

CONVECTION.

761. Limiting Form of Free Convection for Large Grasshof Numbers. D. A. Frank-Kameneckij. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 17. 1–2. *pp.* 9–12, 1937. *In English.*—For free convection the theory of similitude indicates that $Nu = \phi$ (Gr.Pr), where Nu, Gr and Pr are the Nusselt, Grasshof and Prandtl numbers respectively. Experiments have shown that $Nu = K\,Gr^{1/3}$ for large values of Gr. According to the present author this is not a limiting law, and it is shown that at sufficiently high values of Gr a limiting law of the form $Nu = K\,Gr^{1/2}\,Pr$ is to be expected. For such a case it follows that the coefficient of heat transfer must increase proportionally to the square root of the determining dimension, to the 3/2 power of the excess temperature and directly as the pressure. This result is considered to be of importance in the theory of post-explosion heat transfer, and the heat transfer in internal combustion engines, but experimental verification of this is difficult on account of the disturbing effects of radiation and forced convection. R. W. P.

762. Radiation Stresses of Transverse Inertial and Viscous Waves in Liquids. R. Lucas. *Comptes Rendus*, 205. *pp.* 1044–1047, *Nov.* 29, 1937.—In a previous paper [see Abstract 5401 (1937)], the author has stressed the significance and importance of transverse inertial and viscous waves in the thermal agitation of liquids ; here, following a method of analysis used by Brillouin, expression are derived for the components of the radiation stresses developed by the propagation of these waves. Two illustrative examples are briefly discussed. J. S. G. T.

763. Regulation of Heat Loss from the Human Body. J. D. Hardy and E. F. DuBois. *Nat. Acad. Sci., Proc.* 23. *pp.* 624–631, *Dec.*, 1937.—Calorimetric studies of the regulation of heat loss from the human body, carried out during the winter, spring and summer months of 1935 and 1936, the measurements being made in a large respiration calorimeter enclosing one or other of two naked men, are detailed. The temperatures of the men's environment ranged from 23° C. to 35° C., and the observations of temperature, humidity, radiation, convection, vaporisation were made under still conditions, and under the influence of exercise and forced air currents. The effects of chills were studied. The automatic vasomotor regulation of heat loss was effective in environmental temperatures above 28° C. ; with a more or less steady series of chills the temperature of the body was maintained down to an environmental temperature of 23° C. The thermal conductance of the body tissue remained constant below 28° C., the body reacting to temperature changes in this region in much the same way as any warm inanimate object. [See following Abstract.] J. S. G. T.

764. Physical Laws of Heat Loss from the Human Body. J. D. Hardy. *Nat. Acad. Sci., Proc.* 23. *pp.* 631–637, *Dec.*, 1937.—Heat losses from the human body are compared with those from an elliptical, black, galvanised-iron cylinder 50 cm. long, and with axes of lengths 18 and 30 cm. The proportions of heat loss by radiation and by convection from the human body were the same as those from the cylinder. It was found that 78% of the total surface area of the human body lying stretched out with hands close to the body is effective in heat loss. This heat loss increased with a fall in skin temperature when exercise was performed or air currents were used. Under these conditions the heat loss was not proportional to the difference between skin and air temperatures. A depth of 2–3 cms. is involved in the thermal gradient from the internal tissue to the skin surface. Few materials have higher thermal insulating power than living tissue. Superficial circulation plays little or no part in heat transfer at 28°–23° C. Between 28° C. and 30° C. thermal conductance begins to increase with a corresponding increase of superficial blood flow. [See preceding Abstract.] J. S. G. T.

See also Abstract 565.

FUSION AND SOLIDIFICATION.

765. Fusion Point, Vapour Pressure and Heat of Evaporation of Vanadium Oxytrichloride. H. Flood, J. Gørrissen and R. Veimo. *Am. Chem. Soc., J.* 59. *pp.* 2494–2495, *Dec.*, 1937.—Determination of the vapour pressure of vanadium oxytrichloride against saturated water vapour and by lower temperatures in a nitrogen current has been made. By these methods the error due to attack of vanadium oxytrichloride on manometer mercury is avoided. The heat of evaporation has been calculated based upon the results obtained in the investigation. The fusion point of vanadium oxytrichloride has been found to be −79·5°. AUTHORS.

***766. Freezing Point Apparatus. D. Quiggle, C. O. Tongberg and E. M. Fry.** *Indust. and Engin. Chem.* (*Analytical Edition*), 9. *pp.* 579–582, *Dec.* 15, 1937.—The apparatus described has been designed for determining the freezing points of substances which solidify at low temperatures. To obtain reproducible values care has been taken to exclude air from the sample and to keep both the freezing mass and the rate of heat withdrawal constant. The sample is contained within the central of three concentric brass vessels and can be stirred by a magnetically operated device. The brass vessels are supported within a Dewar flask above liquid air, the vapour from which emerges between the two outer tubes and cools the sample. The space around the vessel containing the sample is filled with dry N_2 and the temperature drop through this space is maintained constant by allowing differential thermocouples to operate. a photoelectric relay which regulates the rate of vaporisation of the liquid air. The temperature of the sample is measured by 2, 3, or 5 thermocouples connected in series. Results are given illustrating how freezing point determinations serve to indicate the purity of a hydrocarbon. R. W. P.

See also Abstracts 758, 765, 781.

TEMPERATURE.

767. Improvements in Flame Temperature Measurements. G. Ribaud. *Comptes Rendus*, 205. *pp.* 901–902, *Nov.* 15, 1937.—It is suggested that a heat source having a known linear distribution of temperature could be advantageously employed when optical methods of the Kurlbaum type are used to measure flame temperatures. Light from the source is received by a Lummer cube after traversing two different paths, and the temperature of a luminous flame is obtained directly, by observing the point on the source whose images suffer no change in relative intensity when the flame is inserted in one of the optical paths. For non-luminous flames a similar type of source can be used in conjunction with the spectral-line reversal method. R. W. P.

***768. Quartz Mercury Thermometer. H. Moreau.** *Comptes Rendus*, 205. *pp.* 967–969, *Nov.* 22, 1937.—The examination of a thermometer of fused quartz (although requiring considerable initial correction by reason of variation in the calibre of the tube) over a period of 15 months, during which it was repeatedly heated and cooled between −40° and

+140°, including once for a month at 100°, showed no systematic change in the zero, and none in excess of errors of observation. C. A. S.

See also Abstracts 758, 766, 785, 790, 845 and
404B. Lag in Thermometers. F. Lieneweg.

THERMOCHEMISTRY.

769. Thermochemistry of Perchloric Acid and the Perchlorates. C. F. Goodeve and A. E. L. Marsh. *Chem. Soc., J. pp.* 1816–1819, *Oct.*, 1937.—The heat of solution of dichlorine heptoxide has been measured, and this, combined with the value recently obtained for its heat of formation, gives a value for the heat of formation of aqueous perchloric acid. This provides a convenient basis for the thermochemistry of the perchlorates, since reliable data exist for the heats of neutralisation of perchloric acid, and the heats of solution of its salts. The new basis is about 7·5 kg. cal. different from that previously used. AUTHORS.

770. Flame Velocities. Part I. Theoretical Calculation. W. Jost and L. v. Müffling. *Zeits. f. phys. Chem.* 181. *Abt.A.* 3. *pp.* 208–214, 1937.—Theoretical considerations necessary to be taken into account in discussing the possibility of calculating flame velocities are briefly referred to. In particular it is pointed out that diffusion processes in the combustion zone cannot, in general, be neglected, and that Nusselt's notion of ignition temperature cannot be introduced into the discussion without particular reference to the velocity of reaction. J. S. G. T.

771. Explosive Limits of Gaseous Mixtures. R. Bresquer, M. Rivin and A. Sokolik. *Acta. Physicochimica,* 6. 5. *pp.* 749–754, 1937. *In French.*—The present work has demonstrated the possibility of the spontaneous origin of an explosive wave in mixtures of C_2H_2 and air. The zone which defines the limits of explosivity possesses two minima on analogy with mixtures of H_2 and air. The probable explanation of this phenomenon is suggested as a decline of the spontaneous ignition temperature due to the dilution of the mixtures [see also Abstract 2793 (1936)]. H. H. Ho.

772. Explosion Waves and Shock Waves. Part V. Shock Wave and Explosion Products from Detonating Solid Explosives. W. Payman and D. W. Woodhead. *Roy. Soc., Proc.* 163*A*. *pp.* 575–592, *Dec.* 22, 1937.—The mode of expansion of the disturbance produced when a cartridge of explosive suspended freely is detonated has been studied by means of *schlieren* photography, using cameras of both instantaneous and continuous types [see Abstract 772 (1937)]. The records show that there are three phases in the life of the disturbance produced, *viz.* (1) The detonation of the cartridge (about 3×10^{-5} sec. in a 113gm. cartridge of Celmonite), where the disturbance may be regarded as arising solely from the side of the cartridge and is very nearly spherical; the shock wave is smooth and precedes the front of the gaseous products by a fraction of a centimetre. (2) A larger phase which may last until the disturbance has travelled 100–125 cm. (6×10^{-4} sec. with a 113gm. cartridge of Celmonite). During the first half of this period, the gaseous products are for the most part luminous and follow the shock wave at a gradually increasing distance. The gaseous expansion from each end of the cartridge is far more vigorous than from the side, with the result that axial distensions in the form of the wave appear. In the second half of this period, the disturbance is no longer maintained. (3) When all prominences have disappeared, the wave becomes smooth again and, when travelling at about 500 m./sec. rapidly assumes the spherical form. The wave spreads with a gradually falling velocity until it ultimately degenerates into a sound wave. H. H. Ho.

773. Chemical Inertia. P. Renaud. *Comptes Rendus,* 205. *pp.* 1068–1070, *Nov.* 29, 1937.—It is suggested that the elementary scheme of a chemical reaction in homogeneous phase is analogous to that of mechanical inertia. This new conception of chemical inertia is applicable to any chemical evolution whatever in homogeneous phase. In brief it compares real evolution with tangential evolution, just as in the mechanical conception a real motion is compared with a tangential one. H. H. Ho.

774. Thermal Properties of Heavy Hydrogen. K. Clusius. *Zeits. f. Elektrochem.* 44. *pp.* 21–30 ; *Disc.,* 30–31, *Jan.,* 1938.—This paper deals with the thermal properties of D_2 and its compounds other than water [see following Abstract]. A comparative table is given showing the thermal data for D_2, H D and H_2. In the case of inorganic compounds it is shown that for normal substances the melting points are higher for the H-compounds, whilst for substances, associated in the liquid state, the melting point is higher for the D-compounds. Regarding vapour pressures, it is observed that, in general, at low and medium temperatures, the vapour pressure is lower for the D-compounds, whilst at high temperatures it is lower for the H-compounds. In organic compounds it is found that the replacement of H by D in a carboxyl group causes a fall in the melting point—sometimes by as much as 3·5° C. The characteristic temperature θ is related to the molecular weight M by the equation $\theta_D = \theta_H \sqrt{M_H/M_D}$. Various other relations of entropy and isotopy are discussed. G. G.

775. Thermal Properties of Heavy Water. E. Lange. *Zeits. f. Elektrochem.* 44. *pp.* 31–43 ; *Disc.,* 43–46, *Jan.,* 1938.—This paper gives a general account of, and collects together data, previously reported, of the thermal properties of D_2O, HDO and H_2O. The original should be consulted for the actual data, which are very numerous. It deals with the above mentioned substances in the solid, liquid and gaseous states and in systems composed of one or more of them. It also deals with the isotope effect in the solution of H_2O and D_2O in the same solvent, on the solution of the same solute in H_2O and D_2O, and in the systems of deuterates formed by $Cu\,SO_4$, $Na_2\,SO_4$, Na Br and other salts. The heats of molecular changes $2\,D_2 + O_2 \rightarrow 2\,D_2O$, $H_2O + D_2O \rightarrow 2\,HDO$ and $D_2O \rightarrow D^+ + OD^-$ are also discussed. [See preceding Abstract.] G. G.

See also Abstracts 401, 474, 490, 735, 767.

THERMODYNAMICS.

776. Equation of State of Gases and Critical Phenomena. J. E. Lennard-Jones. *Physica,* 4. *pp.* 941–956, *Nov.,* 1937. *In English.*—After a short review of quantitative determinations relating to the nature and magnitude of intermolecular forces, a treatment is given in which use is made of the inverse power law with the total field expressed in the form $\lambda r^{-12} - \mu r^{-6}$, where r is the distance between the molecules and λ and μ are coefficients. It is shown that force fields can be determined from observations of the equation of state at low pressures, and a method is then given whereby an equation of state applicable to high pressures is derived. The critical temperatures of a gas can then be calculated in terms of the constants of the interatomic field, and it seems that the formula agrees to within a few degrees with observed critical temperatures. That boiling points can also be satisfactorily derived from the same force fields is further evidence in support of the assumptions involved. R. W. P.

777. Generalisation of Boltzmann's Method for a van der Waals Gas. L. Waldmann. *Physica,* 4. *pp.* 1117–1132, *Nov.,* 1937. *In German.*—A general treatment is given of Boltzmann's counting method of determining the velocity distribution and equation of state of a perfect gas from consideration of its possible complexions. Without any assumption of an intermolecular force this treatment leads to an equation of state of the van der Waals type, similar to that previously obtained by Planck [see Abstract 1455 (1908)]. R. W. P.

778. Gaseous Polymerisation and Equations of State. L. Herman. *Comptes Rendus,* 205. *pp.* 1065–1067, *Nov.* 29, 1937.—The author has constructed the curves for the constants *a* and *b* in the van der Waals equation for the cases of O_2 and N_2. The constants *a* and *b* were obtained by solving two equations of van der Waals relating to two neighbouring states of the gas. It was found that both *a* and *b* decreased constantly as the pressure increased. Divergences between experimental and calculated values are due to increase of polymerisation with increase of pressure, and a new equation is derived for the mixture, neglecting terms for the attraction of polymerised molecules since in their cases the residual valencies are saturated. The above equation satisfies the experimental data. A section is devoted to a calculation of the content of polymerised molecules at atmospheric pressure. H. H. Ho.

779. Fugacities in Gas Mixtures. I. R. Krichevsky. *Am. Chem. Soc., J.* 59. *pp.* 2733–2737, *Dec.,* 1937.—An equation is deduced for the computation of the fugacities in gas mixtures subordinate to the Bartlett rule. The examples of the systems $A–C_2H_4$ (to 125 atm.) and $H_2–N_2$ (1000 atm.) prove that the Bartlett rule gives half the error of the Lewis-Randall rule. For these systems an agreement with errors from 2 to 5% with the true fugacity values is attainable, if it be assumed that the fugacity computed in accordance with Bartlett's rule is the geometrical mean of the true fugacity and the fugacity computed in accordance with the Lewis-Randall rule. AUTHOR.

780. Van der Waals Reciprocal Effect of Inert-Gaslike Ions with Consideration of the Electronic Exchange. T. Neugebauer. *Zeits. f. Physik,* 107. 11–12. *pp.* 785–794, 1937.—A method for the calculation of the van der Waals forces is worked out in which polarisability data are taken into account together with the computation of the electronic distribution in the ground state. The results are compared with the approximation formulæ of London, Kirkwood and others. The van der Waals energies of the alkali halides in the NaCl- and CsCl-type have been calculated on the new formula, whereby it was found that for certain Rb halides at low temperatures the CsCl lattice must also be the stable type, in agreement with the experimental findings of Wagner and Lippert. Finally it was discovered that the calculation of the higher approximations in the crystal lattice is bound up with very great difficulties on account of the fact that the essential part of the electronic cloud lies quite outside the Goldschmidt ionic radii. The paper is entirely mathematical. H. H. Ho.

781. Phase Diagram of Water to 45,000 kg./cm². P. W. Bridgman. *J. Chem. Phys.* 5. *pp.* 964–966, *Dec.,* 1937.—At pressures between 20,000 and 25,000 kg./cm². ice VI is transformed into a new modification, ice VII. The melting curve of ice VII has been established up to 190° C. and 40,000 kg./cm^2., and the transition parameters, including latent heat, for this phase change and for the transition VI–liquid, and VII–VI, are tabulated. The triple point, liquid–VI–VII, is at 22,400 kg./cm^2. and 81·6° C. At 50,000 kg./cm^2. and room temperature the volume of VII is approximately 0·60 cm^3./gm. Preliminary values are given for the compressibility of VII. Between 20,000 and 45,000 kg./cm^2., the total proportional volume change is 0·039 cm^3./gm., and the mean compressibility in the range 45,000 to 50,000 is about 0·75 of that in the range 20,000 to 25,000 kg./cm^2. Earlier values for the compressibility of VI [see Abstract 612 (1912)] are now considered to have been too high. R. W. P.

782. Transitions of Solid CH_3D and CD_4. Entropy Relations of CH_3D and HD. K. Clusius, L. Popp and A. Frank. *Physica*, 4. *pp.* 1105–1116, *Nov.*, 1937. *In German.*—In contrast to solid CH_4 which exhibits only one second order phase transition point, at 20·4° K., condensed CH_3D and CD_4 exhibit two such points at 15·5° and 22·6° K. and at 21·4° K. and 26·3° K. respectively. The statistically and calorimetrically determined entropies coincide in the case of CH_4 but in the case of CH_3D they differ by 2·77 e.u. (at 99·7° K. and 1 atm.). This difference which is almost exactly equal to R log 4 = 2·75 e.u. is ascribed to an isotope effect. This arises in that the CH_3D molecules are not fully oriented in the crystal grating but the D atoms are distributed at random over the 4 corners of the tetrahedron ; the orienting force is small compared with the grating energy. The difference between entropies in the case of HD, at 298·1 K. and 1 atm., is 0·10 e.u., the statistical entropy being the lower. The surprising absence of zero-point entropy of amount R log 2 = 1·38 e.u. in the case of HD results in the grating energy being relatively small, ~228 cal., whilst a large zero-point energy, ~260 cal., greatly facilitates the orientation. J. E. K.

783. Third Law of Thermodynamics. F. Simon. *Physica*, 4. *pp.* 1089–1096, *Nov.*, 1937. *In English.*—The present experimental evidence indicates the general validity of Nernst's theorem as a law of thermodynamics. The possiblity that some future experiment may not be in agreement with the theorem obviously cannot be excluded, but unless there is some reason from a theoretical point of view to expect such a result, to anticipate it is mere speculation. So far, no theoretical argument against the theorem exists. On the contrary, the assumption that the state of lowest energy is that of entropy zero, *i.e.*, that of perfect order, is theoretically very plausible. In the author's opinion, therefore, there is no justification for withholding from Nernst's law the status of a general law of thermodynamics. AUTHOR.

784. Thermodynamic Functions of the Chloro- and Bromomethanes, Formaldehyde and Phosgene. D. P. Stevenson and J. Y. Beach. *J. Chem. Phys.* 6. *pp.* 25–29, *Jan.*, 1938.—By use of the harmonic oscillator-rigid rotator approximation the free energy function $(F^0-E_0^0/T)$, and the heat content $(H^0-E_0^0)$ of the chloro- and bromomethanes, formaldehyde and phosgene have been calculated from spectroscopic and electron diffraction data over temperature ranges where the aforesaid approximations are valid. The heat capacity C_p for the bromomethanes, formaldehyde and phosgene have been calculated over the same temperature range as the free energy function and the heat content. The entropies of the ten molecules in the hypothetical ideal gas state at 298·1° K. have been calculated. With the values of $(F^0-E_0^0/T)$ for β-graphite, chlorine, oxygen and hydrogen tabulated by other investigators, with values of this function now given for the chloromethanes, formaldehyde and phosgene and the heat data of Bichowsky and Rossini, the free energy of formation of these molecules has been calculated. **Errata,** *ibid. p.* 108, *Feb.* 1938. AUTHORS.

785. Calculation of Temperatures and Pressures of Combustion in a Closed Vessel. G. Ribaud. *Comptes Rendus,* 205. *pp.* 1139–1141, *Dec.* 6, 1937.—The difficulty of treating the dissociation of the products of combustion by methods of successive approximations is overcome by the use of a generalised QT diagram (Q = heat necessary for the partial dissociation of the molecules and for raising the products of dissociation from T_0 to T). The method is illustrated for the case of the combustion of CO in O_2 to CO_2. N. M. B.

786. Reaction Kinetics. *Faraday Soc., Trans.* 34. *pp.* 1–265, *Jan.,* 1938.—A General Discussion, consisting of 21 reports, divided into three groups as follows :—

Part I. General : Theoretical Methods of Treating Activation Energy and Reaction Velocity.

"Calculation of Activation Energies," by **H. Eyring** (*pp.* 3–11). The statistical theory of reaction rates is reviewed. The semi-empirical method permits of the successful prediction of reaction mechanisms, and the technique of the calculation has already been simplified in many cases.

"Inertia and Driving Force of Chemical Reactions," by **M. G. Evans and M. Polanyi** (*pp.* 11–24). Types of chemical reaction involving a jump in electronic structure are distinguished, and London's theory is applied to them. The energy surfaces of initial and final states are described, and chemical inertia and driving force are defined and discussed with reference to them.

"Transition State Method," by **E. Wigner** (*pp.* 29–41). The problem of calculating rates of reactions is discussed, particularly for reactions which involve no jump in the electronic quantum numbers but change the chemical composition, by the transition state method.

"Theory of Absolute Reaction Rates," by **H. Eyring** (*pp.* 41–48). The general statistical mechanical theory of reaction rates is given and its application reviewed. The thermodynamic theory is developed in terms of the equilibrium constant between the activated complex and reactants. The general theory is applied to photochemical reactions.

"Thermodynamical Treatment of Transition State," by **M. G. Evans** (*pp.* 49–57). The calculation of reaction velocities is treated from the transition state aspect. The influence of external parameters (*e.g.*, hydrostatic pressure) on velocity constant, molecular complexity and the temperature-independent factor, and collision factors in solution, are discussed.

"Application of Equilibrium Theory to Reaction Kinetics," by **E. A. Guggenheim and J. Weiss** (*pp.* 57–70). The present position of the problem is reviewed with particular reference to bimolecular reactions. The application of equilibrium theory to these is discussed in detail. Eyring's treatment of unimolecular gas reactions is criticised. Thermodynamical arguments are also discussed critically.

"Collision Numbers in Solutions," by **R. H. Fowler and N. B. Slater** (*pp.* 81–90). On the basis of a simplified model which involves a quasi-regular crystal structure for a liquid, the number of collisions between molecules in a solution which might lead to reaction is calculated, account being taken of diffusion and repetitive collisions.

"Preliminary Kinetic Approach to the Problems of Ionisation in Solution," by **E. A. Moelwyn-Hughes** (*pp.* 91–104). A semi-empirical method of treating reactions which take place solely in solution, in which the total energy of activation is expressed as the sum of two terms, one of which is independent of temperature, is described. A mechanism for ionic reactions in the gas phase is proposed. Frequency of ionic collisions in solution, dissociation into ions and simple ionisation equilibrium in solution are also considered.

"Present Position of Theory of Reaction Velocity," by **C. N. Hinshelwood** (*pp.* 105–112). The subject is reviewed.

Part II. Experimental Evidence Bearing on the Discussion of Part I.

"Kinetics of Bimolecular Associations in the Gaseous and Condensed Phase," by **A. Wassermann** (*pp.* 128–137). Rate measurements of bimolecular processes in two states are discussed and compared with the kinetics of homogeneous bimolecular and reversible associations.

"Experimental Investigations on the Parameters of the Arrhenius Equation," by **C. N. Hinshelwood** (*pp.* 138–141). Results of experiments in solution are reviewed in order to study the separate variations of the activation energy and the non-exponential term in the Arrhenius equation.

"Influence of Hydrostatic Pressure on Reaction Velocity," by **M. W. Perrin** (*pp.* 144–153). A method of investigating the effect of high pressures on the velocities of reactions in solution is described. Reactions are divided into three types which are found to be differently affected by pressure.

"Linear Free Energy Relationships in Rate and Equilibrium Phenomena," by **L. P. Hammett** (*pp.* 156–165). These can be divided into two groups, in one of which comparison is made between rate and equilibrium in the same reaction series, while in the other the reacting group varies. Each type is discussed, effects of temperature and solvent being considered. The theoretical significance of the relationships is indicated.

"Relationships between Dipole Moments and Reaction Velocities," by **H. B. Watson** (*pp.* 165–171). The literature is reviewed. Simple quantitative expressions in each case seem to be substantiated.

"Rate of Ionisation. Part I. Ionisation of C–H Bonds," by **C. L. Wilson** (*pp.* 175–185). Tautomeric phenomena and proton transfer, and a quantitative relationship between rates of reaction and hydrogen ionisation are discussed.

"Rate of Ionisation. Part II. Ionisation of C-Halogen Bonds," by **E. D. Hughes** (*pp.* 185–202). The Theory of Hughes, Ingold and Patel is reviewed in a general form and illustrated with reference to the decomposition of "onium" compounds and in particular to reactions of alkyl iodides.

"Aliphatic Substitution and the Walden Inversion," by **E. D. Hughes** (*pp.* 202–221). The subject is discussed with reference to the work of Hughes and Ingold.

Part III. Proton Transfer Reactions and H^+-Ion Reactions.

"Kinetics of Proton Transfer Reactions," by **R. P. Bell** (*pp.* 229–236).

"Theory of Proton Transfer Reactions," by **K. J. Pedersen** (*pp.* 237–244).

"Acid Catalysis and Equilibrium Constants," by **W. F. K. Wynne-Jones** (*pp*. 245–251).

"Deuteron Transfer in Solutions," by **K. F. Bonhoeffer** (*pp*. 252–259). An account is given of reactions involving the transfer of a deuteron, and it is shown that they proceed up to ten times more slowly than the corresponding proton transfers. C. B. A.

See also Abstracts 403, 404, 419, 420, 438, 461, 482, 484, 485, 486, 487, 499, 762, 788, 789, 806.

VAPORISATION AND CONDENSATION.

787. Boiling Point of Water at Different Pressures. A. Zmaczynski and A. Bonhoure. *Comptes Rendus*, 205. *p*. 1222, *Dec*. 13, 1937.—Corrects for a calibration error the empirical formula previously given to represent measurements of the boiling point of water in the pressure range 680 to 830 mm. Hg. The corrected result is : $100 + 36\cdot 8863\cdot 10^{-3}q - 20\cdot 017\cdot 10^{-6}q^2 + 15\cdot 33.10^{-9}q^3$, where $q = p - 760$ and p is the pressure in mm. Hg. W. S. S.

788. Boiling Points and Critical Properties of Hydrocarbon Mixtures. R. L. Smith and K. M. Watson. *Indust. and Engin. Chem*. 29. *pp*. 1408–1414, *Dec*., 1937.—Consideration of the principles of additivity of mixtures shows that, for the application to mixtures of correlations of properties of pure components with specific gravity and boiling point, no one type of average boiling point is suitable for all properties. The following different average boiling points have been developed for application to correlations of the various physical properties : (*a*) cubic average boiling point—characterisation factor, viscosities ; (*b*) true molal average boiling point—pseudocritical temperature ; (*c*) mean average boiling point—molecular weight, hydrogen content, heat of combustion, pseudocritical pressure ; (*d*) weight average boiling point—true critical temperatures. Using these average boiling points, new correlations of true and pseudocritical temperature and pressure data are presented which are applicable both to pure components and wide boiling mixtures. AUTHORS.

789. System H_2–N_2–CO and CO Washing. M. Ruhemann and N. Zinn. *Phys. Zeits. d. Sowjetunion*, 12. 4. *pp*. 389–403, 1937. *In German*.—Pressure-concentration equilibrium diagrams of the binary mixtures H_2—CO, and H_2–N_2 at 90°, 83° and 78° K. and for pressures 12–50 atm. are given, together with equilibrium diagrams of the ternary system H_2–N_2–CO at the same temperatures and at pressures 12, 20, 26, 35 and 50 atm. The minimum amounts of liquid N_2 required for washing-out CO from 150 m.^{3} of the ternary mixture in an infinite number of rectifying columns are calculated, and data for the number of columns theoretically required to effect purification to within 0·01 or 0·001% CO under various conditions of pressure and temperature are given, and characteristic features of rectification are briefly discussed. J. S. G. T.

790. Vaporisation of SO_2 with Delayed Boiling and Bubble Formation. E. Haidlen. *Zeits. f. ges. Kälte-Ind*. 44. *pp*. 183–187, *Oct*., *and pp*. 206–212, *Nov*., 1937.—The extent to which a fluid is superheated depends on the rate of vapour transfer across the surface, and decreases when bubble formation occurs. Experiments using SO_2 are carried out which show that temperatures within the liquid can increase with depth below the surface to a depth of about 5 mm. and then become constant. For this fluid there is no sharp distinction between delayed boiling and boiling with bubble formation, both types being possible at vaporisation rates of between 45 and 60 kg./m^{2}hr. There is a definite discontinuity between the temperature of the boiling liquid and its vapour, which varies from 0·1 to 0·7° C. according to the conditions of the experiment. The effect of floating a film of oil on the surface is studied, the extent to which the lower liquid is super-heated being found to depend on the density and viscosity of the oil and on the thickness of the film. R. W. P.

791. Influence of Intensive Desiccation on the Vapour Pressure of Benzene. D. A. Lacoss and A. W. C. Menzies. *Am. Chem. Soc., J.* 59. *pp.* 2676–2682, *Dec.*, 1937.—When purified benzene was desiccated with purified P_2O_5 with precautions to exclude or destroy dust, its vapour pressure, near 80°, was (*a*) lowered markedly if the drying process had been carried on at room-temperature, and (*b*) raised slightly if the drying process had been carried on at 90 or 105°. Without opening the sealed apparatus, the vapour pressure could be caused to revert to the normal value by heating the liquid in the apparatus out of contact with the desiccant, provided that the desiccation had not been too rigorous. Upon allowing access of ordinary air, vapour pressures likewise reverted to normal value. No change was found under like conditions in the vapour pressure of benzene if the materials used were not both purified and also dust free, nor when barium oxide or magnesium perchlorate were used as desiccants. CCl_4, normal heptane and cyclohexane all failed to show any change in vapour pressure upon desiccation under the same conditions that had given positive results in the case of benzene. AUTHORS.

792. Dissociation Pressures of Sodium Deuteride and Sodium Hydride. E. F. Sollers and J. L. Crenshaw. *Am. Chem. Soc., J.* 59. *pp.* 2724–2726, *Dec.*, 1937.—The dissociation pressures of NaH have been measured from 310 to 380°. They are in very good agreement with those of Keyes. The dissociation pressures of NaD have been measured from 270 to 360°. In this range, the dissociation pressures of NaD are approximately twice as great as those of NaH. The following heats of formation per mole have been calculated : for NaH, 14,440 cal. ; for NaD, 15,800 cal. AUTHORS.

***793. Dissociation Pressures of Hydrides and Deuterides of Sodium and Potassium. A. Borocco.** *Comptes Rendus*, 205. *pp.* 983–985, *Nov.* 22, 1937.—A differential manometer method for determining the dissociation pressures of the hydrides and deuterides of Na and K is described. The following values of the dissociation pressures (in mm. of Hg) of DNa and DK respectively at the temperatures stated, are derived : 260°, DNa, 1·1, DK, 1·2 ; 270°, 2·2, 3·1 ; 280°, 5·7, 5·3 ; 290°, 8·5, 8·7 ; 300°, 12·0, 13·8 ; 310°, 20·1, 21·8 ; 320°, 22·6, 33·1 ; 330°, 47·3, 50·9 ; 340°, 70·2, 74·7 ; 350°, 104·3, 107·2. Throughout, values of the dissociation pressures are greater for the deuterides than for the corresponding hydrides. J. S. G. T.

794. Estimation of Deuterium. P. Harteck. *Zeits. f. Elektrochem.* 44. *pp.* 3–6 ; *Disc.*, 6–8, *Jan.*, 1938.—A discussion on methods of estimating D_2 and D_2O. A method of determining the D content of water, making use of the differing vapour pressures of H_2O and D_2O, and the thermal conductivities of their vapours, is described. A. J. M.

795. Diffusion and Vapour Pressure of Zinc in Brass. W. Seith and W. Krauss. *Zeits. f. Elektrochem.* 44. *pp.* 98–102, *Jan.*, 1938.—4 gm. Zn and 2 gm. Cu turnings are placed at either end of a evacuated SiO_2 cylinder heated in a tube furnace with both ends wound independently.

Near the end containing Cu, the bulb is balanced on a fulcrum and counterpoised by weights on the pan of a balance, to the other arm of which it is attached *via* a quartz rod. In this way differences of 0·01 gm. in the weight of Zn are measurable. From the known P-θ relation for Zn, any desired partial pressure of Zn can be maintained by control of temperature at the Zn end of the bulb. This must be the coolest point of the furnace, otherwise results are vitiated by re-condensation of the Zn vapour. Meanwhile the Cu turnings are maintained at a definite higher temperature, alloying takes place, and when the turnings have been completely converted to brass, the composition in equilibrium with the definite partial pressure of Zn can be calculated from the counterpoised weights. Both at 800° and at 850° C., log P rises in a smooth curve for α-brass up to 35% Zn, remains horizontal in the duplex field, and rises again at approximately the same rate for β-brass above 39% Zn. Diffusion data are obtained by substituting 3 Cu balls for turnings, to give a known surface. D. R. H.

See also Abstracts 774, 775.

ACOUSTICS.

796. Propagation of Sound in Gases. H. L. Saxton. *J. Chem. Phys.* 6. *pp.* 30–36, *Jan.*, 1938.—The propagation of sound and supersonic waves in gases has been attacked by Kneser, Richards and Reid, Rose, and others, without taking viscosity and heat conduction into account. Bourgin neglects viscosity. Herzfeld and Rice have taken heat conduction and viscosity into account along with the effect of internal temperature lag of one state. In the present paper, these effects are considered together with the effect of many internal energy states. The general equation is derived for wave propagation in a pure gas of any number of energy states. The probability constants involved are functions of temperature and gas composition only. This equation is first solved for the case of a single two state gas. The solution is then extended to mixtures of gases, including air. AUTHOR.

797. Radial and Torsional Vibrations of Annular Quartz Plates. A. Žáček and V. Petržílka. *Phil. Mag.* 25. *pp.* 164–175, *Jan.*, 1938.—This paper describes the radial and torsional vibrations of circular annular plates. In the case of radial vibrations it has been established that, in accordance with the theory, the frequency of the fundamental mode of vibrations in a full plate is higher than the frequency of corresponding vibrations in annular plates, which frequency declines with the increasing internal radius of the plate. The nodal lines are circles, and their radii, observed in individual plates, accord, within the limits of precision attainable, with the radii figured out from theory. In the case of torsional vibrations it is exactly the other way about. The frequency of the fundamental mode of vibrations in a full plate is, in accordance with the theory, lower than the frequency of corresponding vibrations in annular plates, which frequency increases with increasing internal radius of the plate. The nodal lines are also circles. In the case of all torsional vibrations, the experiments have shown the nodal lines to be circles, but none of the radii of these circles is in accordance with the radii given by theory. In the opening of the plates there arise in case of radial vibrations standing waves in the air, which can easily be shown by lycopodium figures. Both the radial and the torsional vibrations in annular plates can be technically applied in their use as resonators. AUTHORS.

798. Measurement of the Speed of Sound in Liquids by Resonance. C. Sălceanu. *Comptes Rendus,* 205. *pp.* 1219–1221, *Dec.* 13, 1937.—A column of liquid forms a resonator for the particular note considered. The method is due to Bungetzianu, who also supplies a formula, containing the compressibility of the liquid, the elasticity of the container and the thickness and radius of the walls, by which the velocity in an extended mass of the liquid may be obtained. Results are given for 17 liquids, including water, and agree well with those determined directly by Cisman. H. M. B.

799. Transmission of Sound Over Reflecting Surfaces. G. W. Pierce and A. Noyes, Jr. *Acoustical Soc. of America, J.* 9. *pp.* 193–204, *Jan.,* 1938.—The paper presents an experimental and theoretical discussion of acoustic signalling between a sending station and a receiving station near a plane reflecting surface, and is applicable to fog-horn and submarine signalling. The experiments were made with a small scale apparatus employing supersonic waves of a frequency of 67·5 kc./sec. It is shown that at grazing incidence the direct and reflected waves cancel, or partially cancel, as predicted by theory. The cancellation for propagation in air near a water surface, or other surface of high sound velocity and high density, is found to be restricted to angles very near to grazing incidence. On the other hand, theory predicts cancellation for much larger departures from grazing incidence if the reflecting surface has high density but low velocity; experimental curves for transmission over beach sand and certain other substances resemble such theoretical results very closely. Acoustic mirages caused by temperature gradients were studied experimentally, and their effects are shown to be of striking importance in modifying the above results. AUTHORS.

800. Acoustical Detection of Electrically Weak Vibrations in Quartz Plates. W. H. Pielemeier. *Acoustical Soc. of America, J.* 9. *pp.* 212–216, *Jan.,* 1938.—Correlation of extensive results obtained from Y-cut plates with those obtained from X-cut and other plates leads to the conclusion that some thickness vibrations may produce a considerable acoustical effect while their electrical effect may be absent or at least difficult to detect by ordinary methods. The cause of this condition is thought to be the relatively strong electrical effect of the shear vibration or of certain length vibrations (harmonics) that happen to be quite near the mechanical thickness frequency responsible for the detected sound waves. Obviously the latter is more effective in producing sound waves travelling normal to the plate. The effect of humidity on the wave velocity was also studied. Two dispersion regions in air were discovered. [See also Abstract 3587 (1935).] AUTHOR.

801. Supersonic Waves in Gases. D. Riabouchinsky. *Comptes Rendus,* 205. *pp.* 1115–1117, *Dec.* 6, 1937.—It is shown that the results previously obtained [see Abstracts 1998 and 3019 (1936)] for the motion of supersonic waves can be derived without the introduction of a complex variable. R. W. P.

802. Electrical Responses of the Ear. E. G. Wever and C. W. Bray. *Am. Phil. Soc., Proc.* 78. 2. *pp.* 407–410, 1937.—The electrical responses of the cochlea during sound stimulation were observed in guinea pigs, cats, opossums, and pigeons. Characteristic differences were found in (1) the range of frequencies over which responses occurred, (2) the functional relation between magnitude of response and stimulus intensity, and (3) the variation of sensitivity with frequency. The results form a basis for the comparative study of the auditory mechanism. AUTHORS.

803. Directive Effect of Sound Field on Non-Spherical Particles. R. Pohlman. *Zeits. f. Physik*, 107. 7–8. *pp*. 497–508, 1937.—The paper treats of the effect of stationary ultrasonic waves on the motion and direction of small Al particles suspended in xylol. One dimension of the particles is smaller than the other two, and the particles can be regarded as small freely suspended Rayleigh discs of 20 μ dia. and thickness $1 \cdot 5\ \mu$. Employing King's theory [see Abstract 410 (1935)], the turning moment exerted by the field on the particles is expressed in terms of ρ_0/ρ_1, the ratio of the densities of xylol and Al. When this ratio is zero or unity the directive effect is zero, and it attains a maximum when the ratio is about 0·35. The time of " migration " is 0·06 sec., and the time of directional adjustment 0·67 sec. Quite weak sound fields are capable of producing the effects. The rotation of the particles introduces subsidiary changes such as variation in the dielectric factor. This effect could be used for measuring weak sound fields. G. E. A.

See also Abstract 415.

ELECTRICITY AND MAGNETISM.

ALTERNATING-CURRENT NETWORKS.

804. Solution of Variable Circuits by Matrices. L. A. Pipes. *Frank. Inst., J.* 224. *pp*. 767–777, *Dec.*, 1937.—It is the purpose of this paper to present a method for the numerical solution of circuits whose parameters vary with the time. The method is not limited to electrical networks but any electrical or mechanical system whose behaviour may be expressed by an ordinary homogeneous linear equation with variable coefficients. This method is particularly well adapted to the solution of the free oscillations of circuits whose parameters are periodic functions of the time. This class of problem is of great technical interest both in engineering and in physics. AUTHOR.

***805. Zero-Shunt Valve A.C. Potentiometer. J. J. Dowling.** *Phil. Mag.* 25. *pp*. 184–188, *Jan.*, 1938.—The use of the zero-shunt in the anode circuit of a detector valve enables the p.d. across an impedance carrying an alternating current to be balanced against the p.d. across an adjustable resistance in which the same a.c. flows. Measurements are possible of impedances, phase-angle, frequency, etc., at high or low frequency and with considerable precision. AUTHOR.

See also Abstract 833.

CONDUCTION AND DISCHARGE IN GASES.

806. Thermodynamics of Ionisation. K. H. Riewe. *Zeits. f. Physik*, 107. 9–10. *pp*. 680–682, 1937.—Saha's formula for ionisation equilibrium and its dependence on temperature is deduced from general thermodynamical considerations. A slight difference between the formulæ is shown not to be due to the assumption of a stationary nucleus. F. C. C.

807. Nature of the Oscillating Spark Discharge. A. Ionescu. *Zeits. f. Physik*, 107. 11–12. *p*. 795, 1937.—Criticises Purcaru's work on this subject [see Abstract 2204 (1935)] and states that he could not have obtained so great an accuracy as Feddersen in determining the form of the oscillation. W. S. S.

808. Characteristic of the Copper Arc During the Formative Period. P. L. Betz and S. Karrer. *J. of Applied Physics*, 8. *pp.* 845–848, *Dec.*, 1937.—This paper gives the results of an investigation of the voltage characteristic of the copper arc in air during the process of arc formation. A pair of copper electrodes, initially in contact and carrying current, were separated and the voltage arising across the arc gap was studied. Kathode-ray oscillograms indicate that at the instant of contact separation there develops across the gap a voltage of about 12·2 V. This voltage was attained in less than 10^{-5} sec. This rapidly developed voltage was found to be independent of arc current for current values up to 100 A, which suggests that the rapidly developed initial voltage corresponds to the kathode fall of the arc. AUTHORS.

809. Investigation of Electric Arc in Gravity-Free Space. M. Steenbeck. *Zeits. f. techn. Physik*, 18. 12. *pp.* 593–595, 1937. *Phys. Zeits.* 38. *pp.* 1019–1021, *Dec.* 1, 1937.—An arc between carbon electrodes, with a separation of 3 cm. and arc current of 1 to 8 A, was maintained in a vessel which could fall freely, between guides practically free from friction, through a height of 3·5 m. The disturbing warm air current which is found in the case of a stationary arc in air was thereby eliminated. The arc in the falling tube differs from the ordinary arc in its lower potential for the arc column, greater stability, especially for long arcs, and much smaller current density with increasing arc current. In the arc plasma a mechanical tractive effect occurs, which is due to the electrostatic forces between the individual ions and the plasma electrons. Calculation of the tractive effect in a similar manner to that for determining the cohesive pull in strong electrolytes according to the Debye-Hückel theory gives results of the right order of magnitude. A. W.

810. Effect of Current Density on Ionisation Phenomena in Self-Maintained Discharges in Rare Gases. R. Schade. *Zeits. f. techn. Physik*, 18. 12. *pp.* 595–598, 1937. *Phys. Zeits.* 38. *pp.* 1021–1024, *Dec.* 1, 1937.—The phenomena of a falling initial characteristic and the lowering of the striking potential by radiation observed in the pure rare gases are not attributable to space charge effects. Their explanation is closely bound up with secondary ionisation processes which depend on the square of the current density. In the case of the pure rare gases such ionisation is probably due to impacts of every pair of metastable atoms. If the metastable atoms are eliminated by admixture of small quantities of foreign gas, the effects observed in the pure rare gases are altered very much. Various observations point to the conclusion that, as regards current density, the glow discharge is the most favoured. A. W.

811. Characteristics of Probe Electrodes in a Contracted Discharge. S. Gvosdover. *Techn. Phys., U.S.S.R.* 4. 9. *pp.* 717–721, 1937. *In English.*—Experimental determinations were made of probe electrode characteristics in a contracted discharge. The results obtained indicate a Maxwellian distribution of the electrons in such discharges. It is shown that by the use of probes in contracted discharges it is possible to determine the magnitude of the electron current, the temperature and to estimate the order of magnitude of the ionic current. The results obtained confirm those of Elenbaas. [See also Abstract 313 (1937).] A. W.

812. Electric Discharges in Neon. H. J. Lindenhovius. *Physica*, 4. *pp*. 1212–1223, *Dec.*, 1937. *In German.*—This is an investigation of the connection between the striking potential and frequency of an a.c. discharge in neon. For low frequencies, *i.e.*, 0 to 10^4 ∼, it is found, by means of a rotating mirror, that in each cycle the discharge lights up and goes out again. To start the discharge for the first time a potential V_1 is needed, but in order to make it light up again in the following cycles a lower potential V_2 is required. The variation of V_1 and V_2 with frequency, gas pressure and distance apart of the electrodes is studied. For high frequencies, 10^5 to 10^7 ∼, a potential V_1 is again required to start the discharge ; but it is found that the discharge can be kept alight throughout the whole cycle if the potential does not sink below a minimum value V_3. These potentials V_1 and V_3 are studied with respect to frequency, gas pressure and electrode distance. A theoretical explanation is given : it differs from that of W. Fucks [see Abstract 817 (1937)]. G. G.

813. Examination of Electron Surge in the Expansion Chamber. H. Raether. *Zeits. f. techn. Physik*, 18. 12. *pp*. 564–566, 1937. *Phys. Zeits.* 38. *pp*. 990–992, *Dec.* 1, 1937.—The expansion chamber is used to examine the behaviour of an electron surge produced by an applied impulse. The length, breadth and general properties of the cloud tracks obtained are such as would be expected on present theory of the motion of electrons in gases. F. C. C.

814. Charge of Slow Ions with Positive Resonance Energy Defect. F. Wolf. *Zeits. f. techn. Physik*, 18. 12. *pp*. 566–568, 1937. *Phys. Zeits.* 38. *pp*. 992–994, *Dec.* 1, 1937.—The change of electric charge of ions is examined as a function of the energy. A positive defect in the internal resonance energy produces little effect, energy being derived from other sources to make up the balance. F. C. C.

***815. Interpretation of Tube Counter Data. J. Meixner.** *Ann. d. Physik*, 30. 8. *pp*. 665–682, *Dec.*, 1937.—A general mathematical treatment for results obtained with tube counters is derived. Applications of the method are made to sources with exponential decay and means of assessing the contribution of various perturbing factors are exemplified. F. C. C.

816. Super-Temperature in the Dark Space of the Glow Discharge. A. Güntherschulze and W. Bär. *Zeits. f. Physik*, 107. 9–10. *pp*. 642–652, 1937.—The equations of the conduction of heat for a glow discharge between two plane electrodes of constant temperature are deduced. The electrodes, with a glass ring separating them, form the discharge vessel. The results show that there is for a 2000 V kathode fall and a current density of 0·5 mA/cm^2. in A, a mean super-temperature of 2127° C., if it is assumed that the total energy of the kathode fall is taken up in heating the gas in the dark space. On the contrary the measurements in various gases from the pressure change on switching on and off the discharge give super-temperatures of the order of magnitude of 10° C. Since a portion of this insignificant super-temperature is produced by warming of the gas by electrons flying from the kathode to the anode it follows that the amounts of energy which the kations give up to the gas are so small that they have no appreciable effect on the energy given up at the kathode. Hence it follows further that the accommodation coefficient is here equal to 1. Further investigation is being made of the consequences of these results. J. J. S.

817. Liberation of Electrons by Positive Ions Rebounding from an MgO Kathode in the Anomalous Glow Discharge. A. Güntherschulze and W. Bär. *Zeits. f. Physik,* 107. 11–12. *pp.* 730–740, 1937.—The dependence of the energy Q liberated at an MgO-kathode by impact of various positive ions is examined calorimetrically between 500 and 2500 V. The Q-V curve is the same for He, Ne, A and H_2 but lies somewhat higher for N_2, O_2 and some rare gases. It is shown that the curve allows an estimate to be made of the liberation of electrons from the kathode due to the impact of the bombarding ions. The electron intensity rises linearly from zero at about 125 V, the gradient being dependent on the electron work-function of the particular kathode. F. C. C.

818. Charge Exchanges of H and He Canal Rays in Gases in the Velocity Range 30 to 200 ekV. H. Meyer. *Ann. d. Physik,* 30. 7. *pp.* 635–649, *Dec.,* 1937.—Measurements were made of the ratio of charged to uncharged particles in a pencil of canal rays of given velocity after the pencil had traversed a given length of gas at known pressure. As the pressure of the gas is increased the ratio tends to a limiting value *w* which depends on the velocity. H canal rays were found to give a rapid increase of *w* with increase in velocity for all the gases studied (air, H_2, He). The mean free path of charged canal rays also increased rapidly with velocity, especially in He and H_2, but the free path of neutralised canal rays decreased with velocity in H_2, increased in He and air. He canal rays were found to show a greater tendency to neutralisation and less variation of *w* with velocity. The free paths of the charged and neutralised particles were of the same order of magnitude. In H_2 these free paths had a minimum value at a velocity of about 80 ekV. W. S. S.

819. Optical Excitation of Gases by Canal Rays of Hydrogen and Deuterium. W. Hanle. *Zeits. f. techn. Physik,* 18. 12. *pp.* 569–572, 1937. *Phys. Zeits.* 38. *pp.* 995–998, *Dec.* 1, 1937.—The optical excitation of He and A by electrons and by canal rays of H and D is compared. The governing factor is the velocity of the exciting particle. For the same energy, H produces more effect than D, while for the same velocity the behaviour is reversed. The measurements are in good agreement with theory. The translational velocity imparted to the excited He nuclei produced a disturbing factor due to loss of excitation energy by collision of the second kind. The quenching cross-section was determined from the variation of intensity with pressure. F. C. C.

820. Probability of a Stepwise Excitation of Mercury Atoms. V. Fabrikant and I. Cirg. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.,* 16. 5. *pp.* 263–266, 1937. *In English.*—From measurements of the variation with current of the aggregate intensity of the lines 4047, 4358, and 5461 in the radiation from a low pressure Hg discharge tube in which the vapour pressure was maintained constant, quantitative data on the stepwise excitation of Hg atoms were obtained. By stepwise excitation is meant the raising to higher levels of already excited Hg atoms by electron impact. Stepwise excitation was found to contribute an increasing proportion of the intensity with rise in the current. The effective cross-section of Hg atoms for the stepwise excitation involved was determined. W. S. S.

821. Large Angle Scattering and Energy Loss of Potassium Ions Scattered by Heavy Monatomic Gases. A. G. Rouse. *Phys. Rev.* 52. *pp.* 1238–1244, *Dec.* 15, 1937.—A beam of K ions with energies in the range between 90 and 360 V was scattered by collision with the heavy monatomic gases A, Kr, Xe and Hg vapour and the angular distribution was observed. For slower particles the scattering per unit solid angle relative to the centre of mass of the colliding particles decreases with angle. At higher voltages the scattering increases at larger angles with a minimum about 60. The scattering at the larger angles increases with voltage. The results are not compatible with a rigid sphere model of the atom. The large deviations may be associated with exciting or ionising collisions. AUTHOR.

822. Effect of Atomic Hydrogen on Synthesis of Ammonia under Positive Ion Impact. A. Gelbart and I. Mochan. *Acta Physicochimica*, 6. 5. *pp.* 767–777, 1937. *In English.*—The yields during NH_3 synthesis under positive-ion impact have been measured and the absence of proportionality between ionic current and yield of NH_3 has been verified. Experiments on the synthesis of NH_3 during an additional generation of atomic H on a glowing W filament have also been carried out, and the reaction rate in this case found to rise with increase of ionic current. When the yields per ion for the case of the additional formation of atomic H were calculated, it was found that they did not depend on the ionic current but were between 0·1 and 0·3. The experiments indicated that the presence of activated N atoms and H was essential to the synthesis of NH_3. Possible mechanisms of the above reaction are discussed and the deduction made that it proceeds on a cooled wall where an adsorbed atomic H-layer is available. H. H. Ho.

823. State of Equilibrium between Large and Small Ions in a Gas. Ouang Te-Tchao and A. Langevin. *Comptes Rendus*, 205. *pp.* 1049–1051, *Nov.* 29, 1937.—Large ions are formed in a gas by the attraction of neutral particles by small ions and lost by recombination of large positive and negative ions. After a time the number formed is equal to the number lost, so a state of equilibrium is reached. It is deduced theoretically that at this stage (1) a certain percentage of particles remain neutral, (2) the large negative ions are slightly in excess of the large positive ions, (3) the equilibrium is independent of any charged particles which may have been there originally and (4) the proportion of ions depends solely on the size of the particles in the gas. Experimentally a gas charged with smoke is circulated through a measuring condenser after passing through an ionisation chamber. The ratio N/P of large positive to large negative ions is found to be 1·4 and the theories 1, 2 and 3 are verified. H. M. B.

See also Abstracts 442, 614, 615, 617, 720, 872 and

353B. Electric Spark as a Source of Photo-Ionisation. A. Wallraff and E. Horst.

CONDUCTION IN SOLIDS AND LIQUIDS.

***824. Two-Valve Voltmeter. W. C. Michels.** *Rev. Sci. Instruments*, 9. *pp.* 10–12, *Jan.*, 1938.—By the use of two type-37 valves it has been found possible to design a high impedance voltmeter which possesses an approximate voltage squared characteristic, and is therefore suitable for the measurement of r.m.s. values of alternating potentials. The circuit of the voltmeter is such as to make the readings independent of appreciable fluctuations of the battery potential supplied to the valves. AUTHOR.

825. H.F. Resistance of Cylindrical Conductors. E. P. Adams. *Am. Phil. Soc., Proc.* 78. 2. *pp.* 271–285, 1937.—When plane electric waves of very high frequency are guided by any system of cylindrical conductors, the axes of the cylinders being normal to the plane of the waves, an approximate value for the resistance of unit length of one of the cylinders is given by the expression, $R = (2\pi\mu\tau p)^{\frac{1}{2}} \int\sigma^2 ds/[\int\sigma ds]^2$, where σ is the surface density of the charge on the conductor in the corresponding problem of the distribution of electricity on the cylinders, the integrals being taken around the contour of the cylinder in the plane of the waves. τ is the specific resistance of the conductor, μ its magnetic permeability, and p is equal to 2π times the number of vibrations per second. The only problems for which a solution has been obtained for any frequency are those of two coaxial circular cylinders and two parallel circular cylinders external to each other. It is shown that the limiting values for high frequencies deduced from these solutions are the same as those given by the expression quoted above. This is then applied to some problems for which the general solution has not been obtained, but for which the corresponding electrostatic problems have been solved. These problems are those of two circular cylinders, one inside the other, but placed eccentrically; two semi-circular cylinders separated a short distance; and two thick circular cylindrical shells. The self-inductance and capacity of unit length of circuits formed of two of these cylinders are also given. AUTHOR.

826. Effect of Tension on Electrical Resistance of Single Tetragonal Tin Crystals. M. Allen. *Phys. Rev.* 52. *pp.* 1246–1249, *Dec.* 15, 1937.—The adiabatic tension coefficient of resistance of single tetragonal tin crystals has been determined for various orientations. Bridgman's theory, as modified by Cookson, has been extended to the tetragonal case and the experimental points found to lie within experimental error on the curves computed according to this theory. As measured directly, the tension coefficients depend both on the primary and secondary orientations of the crystal; for $\theta = 90°$ they depend on the secondary orientation which is contrary to what has been found in the case of the trigonal crystals studied. The tension coefficients for specific resistance are found by allowing for the change in resistance which necessarily arises from the change in dimensions and these are found to be independent of the secondary orientation whatever the primary orientation, again contrary to what holds for trigonal crystals. [See also Abstract 1315 (1936).] AUTHOR.

827. Configuration of Carbohydrates by Conductivity Measurements in Boric Acid Solution. H. T. Macpherson and E. G. V. Percival. *Chem. Soc., J. pp.* 1920–1927, *Dec.,* 1937.—Böeseken's conclusions on the configuration of α- and β-*d*-glucose are confirmed, since conductivity and viscosity experiments with glucose, α-methylglucoside, and various methylated glucose derivatives make it clear that the only hydroxyl groups in glucose having any effect on the conductivity of a boric acid solution are those on C_1 and C_2. By using **3 : 4** : 6-trimethyl α-mannopyranose, the configuration is shown to be *trans-* with respect to the OH groups on C_1 and C_2, in contradistinction to Böeseken's results for β-mannose. A striking elevation of conductivity is found for α-methylmannofuranoside, which is attributed to the orientation of the OH groups, four being situated in close proximity to one another; γ-methylglucoside, where three OH groups are close to one another, gives a lower elevation, and γ-methylgalactoside a depression. The behaviour of α-*l*-sorbose appears to be anomalous. AUTHORS.

828. Conductivity Measurements for Control and Regulation of Processes. O. Dobenecker. *Zeits. f. techn. Physik*, 18. 11. *pp.* 387–390, 1937.—The use of conductivity measurements for the control of chemical processes is discussed. The use of the methods proposed for the detection of SO_2, COS, H_2S and CS_2 is described. The limitations of the method for determining the salt content of solutions are examined, and the general applicability of the method for particular technical instances is considered.

F. J. B.

See also Abstracts 805, 887, and

366B. New H.F. Ammeter. H. Straubel.

367B. Resistance Amplifier Voltmeter with Constant Relative Sensitivity. G. A. Beauvais.

369B. Transient Maximum and Minimum Voltages by Thyratron Potentiometer. A. Hickling and J. H. Bruce.

371B. Measurement of High Resistance with a Thyratron. J. L. Eck.

410B. Theory of the Johnson Effect, Especially at Supraconductivity. H. Baerwald.

DIELECTRICS AND CAPACITANCE.

829. Dipole Moments of Vapours. Parts IV, V and VI. L. G. Groves and S. Sugden. *Chem. Soc., J. pp.* 1779–1784, *Oct., and pp.* 1992–2000, *Dec.*, 1937.—For Part IV measurements are recorded of the dipole moments of a number of aliphatic ethers and amines in the vapour state. For diethyl ether a large number of observations has been made over a temperature range of 190° and the results analysed by the method of least squares. It is found that the moment deduced from the slope of the P–$1/T$ curve is 1·18 D, and that the constant term in Debye's equation has a value which gives an atomic polarisation which is only 8% of the value of P_E measured for the sodium-D line. For three other ethers and three aliphatic amines a smaller number of observations has been made and analysed in a similar manner. In general, it has been found that the moment deduced from the slope of the P–$1/T$ curve agrees with that calculated on the hypothesis that P_A is 5% of P_E. In Part V observations are recorded of the dipole moments of 16 aromatic compounds in the vapour state. In two series of *o*-, *m*-, and *p*-isomerides it is found that the observed moments for the *m*-compounds agree with the values calculated by the simple vector addition of group moments, whilst the *o*-compounds show large discrepancies. In Part VI an approximate method has been worked out for calculating the induced dipoles produced in the non-polar parts of a molecule by induction from a primary dipole. This method, which is a development of that suggested by Frank [see Abstract 4673 (1935)] allows for the rapid variation of electric field in the neighbourhood of the dipole. When these induced moments are allowed for, fairly consistent bond moments for polar groups can be obtained from the data for aliphatic compounds. When these bond moments are used to compute the moments of aromatic compounds, it is found that in these substances additional moments are present which are identified as the mesomeric moments which correspond with the permanent electronic displacements postulated in the general electronic theories of organic reactions. The directions of the mesomeric moments obtained from the dipole observations are in agreement with those deduced from organic reactions. In general, aromatic compounds containing ortho-para-directing groups exhibit large mesomeric moments whilst those containing meta-directing groups possess much smaller mesomeric moments. [For Part III see Abstract 1343 (1937).] AUTHORS.

830. Dipole Moments of Aromatic Diazoamino-Compounds. R. J. W. Le Fèvre and H. Vine. *Chem. Soc., J. pp.* 1805–1819, *Nov.*, 1937.—The dipole moments of diazoaminobenzene and some of its halogen, nitro-, and alkyl-derivatives have been calculated from the observed dielectric constants, densities, and refractive indices of the compounds in benzene solution. The results indicate that the angle between the two aryl groups is about 140°. There is a slight decrease in the polarisation of diazoaminobenzene with concentration, but the results do not support the view that only non-polar dimeric molecules are formed. A. J. M.

831. Solvent Effect in Dipole-Moment Measurements. Part I. Polarisation of CCl_4 Solutions. F. R. Goss. *Chem. Soc., J. pp.* 1915–1920, *Dec.*, 1937.—The dielectric polarisation of polar substances in solution is known to differ from the same polarisation measured in the vapour state by amounts which are described in general as "solvent effects." It is already known that these are connected with the electrical anisotropy of the solvent, the concentration, anisotropy, and degree of association of the solute, and any chemical reaction which may occur between solvent and solute. It is now shown that for certain solutions of polar substances in the isotropic solvent, CCl_4, the variation in the partial molar polarisations (Ps), obtained by the method of intercepts from the polarisations (P_{12}) of the mixtures, can be expressed as a function of the dielectric constant ϵ in the form :

$$P_s = P_{E+A} + Z(\epsilon - 1)^4/(\epsilon + 2)^4 \; Y/\epsilon.$$

Here Y and Z are molar quantities whose ratios (Y/P_0 and Z/P_{E+A}) to the orientation and to the distortion polarisations respectively are, in the same way as $(P \quad - P_{E+A})P_0$, a measure of the modification of the magnitude of the polarisation by the anisotropy. These quantities are found to be related by the formula

$$(Y/P_0 - 1)/[\sqrt[4]{(Z + P_{E+A})P_{E+A}} - 1] = 3\cdot 25$$

by means of which the solvent effects due to anisotropy and change of concentration may readily be defined and calculated. Values for the dipole moment obtained by means of these formulæ from suitable experimental data are in satisfactory agreement with those given by the vapour measurements. AUTHOR.

832. Dielectric Constant and Particle Size. N. M. Li and J. W. Williams. *J. Phys. Chem.* 41. *pp.* 1171–1181, *Dec.*, 1937.—The dielectric behaviour of solutions of chlorinated rubber in benzene and CCl_4 has been investigated. At moderate solute concentrations evidence is found for a polarisation due to the rotation of the molecular unit as a whole. The molecular weight calculated from dispersion of dielectric constant data for these solutions by assuming rotation about the long axis is believed to be of the correct order of magnitude. At all concentrations studied there is an additional polarisation contribution to the dielectric constant (tentatively ascribed to restricted rotations of the recurring groups within the molecule in the electrical field), but a variation of this contribution with wave-length (10 to 1000 m.) is not observed. In dilute solution variation with wave-length due to the ordinary molecular rotations in the electrical field cannot be detected. Molar dielectric constant increment and molar dipole moment for chlorinated rubber are small. AUTHORS.

833. Dielectric Measurements of Hydrophilic Colloids. Part III. H. R. Kruyt and J. T. G. Overbeek. *Kolloid Zeits.* 81. *pp.* 257–269, *Dec.*, 1937.—Previous work [see Abstract 317 (1938)] is now continued on the measurements of the dielectric constants of a number of lyophilic colloids by means of a resonance method employing a wave-length of 0·857 m. Special care was exercised with respect to the conductivity of the sols and the accuracy attained amounted to 0·1–0·2% of the dielectric constant. In all the cases investigated the dielectric constant was lower than that of water and the lowering was proportional to the concentration of the colloid. If the dielectric constant is calculated according to a simple rule of mixtures based on the theory of Wiener, then all the values appear to be higher than the calculated values. The influence of temperature on the dielectric constant was investigated over the range 20–49° C., when certain colloids (*e.g.*, agar, gelatin, gum arabic) exhibited dispersion of the constant. The influence of gel formation, pH, additions of salts and tannin, and the effect of complex-coacervation have also been investigated. The general conclusion drawn is that no lowering of the dielectric constant has been established as a consequence of hydration. H. H. Ho.

834. Frictional Dispersion of the Dielectric Constants of Organic Fluids. E. Plötze. *Zeits. f. techn. Physik*, 18. 12. *p.* 588, 1937. *Phys. Zeits.* 38. *p.* 1014, *Dec.* 1, 1937.—Determination of the variations with concentration and temperature, in the frictional dispersion (as deduced from the relaxation times) of polar organic substances in non-polar viscous solvents (λ varying from ultra-short to 10 cm.), contributes to a determination of the internal friction, and hence also of the molecular diameter of the polar organic substance. C. A. S.

835. Dielectric Properties of Solid Hydrochloric Acid. G. Hettner, E. Hettner and R. Pohlman. *Zeits. f. Physik*, 108. 1–2. *pp.* 45–54, 1937.—Measurements made at wave-lengths between 30 and 5,000 m. show that at temperatures below the solidifying point (−174° C.), anomalous dispersion and absorption effects are observed, which reach a maximum at the solidifying point. At − 186° C. dispersion and maximum dielectric loss occur at 300 m. wave-length ; at higher temperatures these effects are found at shorter wave-lengths. E. R.

836. Electrical and Optical Properties of Oxides of Cd, Tl and Sn. G. Bauer. *Ann. d. Physik*, 30. 8. *p.* 744, *Dec.*, 1937.—Corrections to the original paper [see Abstract 5432 (1937)].

837. Relation between the Energy Constant (ϵ) and the Quantity Constant (a) in the Conductivity-Temperature Formula of Oxide Semiconductors. W. Meyer and H. Neldel. *Zeits. f. techn. Physik*, 18. 12. *pp.* 588–593, 1937. *Phys. Zeits.* 38. *pp.* 1014–1019, *Dec.* 1, 1937.—The relations between the constants a and ϵ in the formula $\sigma_T = ae^{-\epsilon/kT}$ [see Abstract 2228 (1935)], connecting conductivity (σ) and temperature (T), has been investigated by determining σ at 0° and 400° for various values of ϵ, for TiO_2, Fe_2O_3, ZnO and UO_2 ; the following curves being plotted : (I) log σ—log a ; (II) ϵ—log σ ; and (III) ϵ—log a. All the curves are straight lines. In particular (III) shows a distinct difference in relation according as σ_{20° is $<$ or $>$ $10^{-2}\ \Omega^{-1}\,\text{cm.}^{-1}$. If less, as in TiO_2, Fe_2O_3 and ZnO, it is steeply inclined to the log σ axis, if greater (UO_2) almost parallel thereto and much smaller, σ to a first approximation being equal to *a*. These results are discussed in detail in the light of existing theories of electronic conductivity. C. A. S.

See also Abstracts 403, 404, 707, 708, 825, 853, 873, 875 and

355B. Dielectric Losses in Inorganic Glasses at Radio Frequencies. N. Bogorodickiy and I. Friedberg.

356B. Dielectric Properties of Insulating Materials. E. J. Murphy and S. O. Morgan.

ELECTROCHEMISTRY.

838. E.M.F. of Non-Isothermal HCl Galvanic Cells. Z. Szabó. *Zeits. f. phys. Chem.* 181. *Abt.A.* 3. *pp.* 169–182, 1937.—HCl thermo-cells are investigated with very carefully prepared Ag-AgCl electrodes, whereby values constant to a few micro-volts can be obtained. From temperature-coefficient determinations, the activity coefficients for $H^{\cdot}$ and Cl' ions are calculated. For moderate concentrations (below 0·2 M), these are found to be equal. Thermo-e.m.f.'s are almost exactly proportional to temperature differences. From electrolytic Peltier-heats as determined calorimetrically by Lange and Hess [see Abstracts 4714 (1932) and 4300 (1933)] it can be deduced that heats of transport are independent of concentration over a wide range, consequently ionic-activities can be deduced approximately for higher concentrations, provided that ionic heat of dilution is negligible. When the diffusion potentials calculated from these assumed activities are compared with those obtained from Hermans' equation $\epsilon = \text{const.} - 37\cdot92\ (\log_{10}c - 0\cdot383\sqrt{c})$, good agreement is shown. By applying corrections in accordance with Debye and Hückel's ideas, the agreement is still closer. D. R. H.

839. Electrolysis of Molten Salts. P. Drossbach. *Zeits. f. Elektrochem.* 43. *pp.* 891–907, *Dec.*, 1937.—The molten salts and mixtures examined are $PbCl_2$ at 540° and 680°. KCl + $MgCl_2$ mixed (1 : 1 and 1 : 3). alone or with addition of varying amounts of one or more of $BaCl_2$, $CaCl_2$, NaCl or NaF at 740°, LiCl at 640° and NaCl alone or with one or more of NaF, KCl, or Na_2CO_3, from 660° to 815°. Full details of methods are described. The current strength (I) varied from 0·05 to 1 A. The polarisation voltage (P), calculated as the p.d. used less (I × resistance), and current yield are given. The highest current yield in production of Pb was 96·2% with I = 1 A. at 540°; for Mg 75·3% from KCl and $MgCl_2$ in equal proportions and I = 0·50 A., but 83% from KCl.$MgCl_2$ + 12% $BaCl_2$ and I = 1 A. [See Abstract 3403 (1934).] C. A. S.

840. Potentials of Silver and Other Metals in Solutions of Halogen Salts. I. P. Morkovko and E. W. Zmačinskij. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 17. 4. *pp.* 211–213, 1937. *In German.*—The potential jump, E, at the surface of Ag in solutions (0·001–4 *N*) of NaCl, NH_4Cl, $BaCl_2$, $CdCl_2$, and KI was examined. Stable and reproducible results were obtained after a varying interval (1 hr.-3 days). This was longer if the electrode was greasy. E decreased with increased concentration (*e.g.*, 0·3398 for 0·001 *N* NaCl, 0·1005 for 4 *N*); E in concentrated, but not in dilute, solutions was diminished by shaking, *e.g.*, in saturated NaCl from 0·110 to 0·092, but recovered its original value on standing. The temperature coefficients between 18° and 50° are between 0·001 and 0·008°. With the same electrolyte for different metals E increases with the electropositive character of the metal thus for Ni, Cu, Ag, Au and Pt in 0·1 *N*-KCl it is respectively −0·493 + 0·089, 0·279, 0·369, and 0·405. The results are expressible by the

formula $E = a + b\log cf$, where cf is the activity of the electrolyte, and a and b are constants, but different for solutions of < and > 0·5–1·*ON*.
C. A. S.

841. Theory of Potential Jump at Metal Surfaces in Solutions of Other Ions. I. P. Morkovko and E. W. Zmačinskij. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 17. 4. *pp.* 213–216, 1937. *In German.*—Arguments are adduced (*e.g.*, the solubility of Ag or Cu in the solution of a halogen salt is demonstrated) in support of the theory that the potential jump at the surface of a metal in a solution of a foreign ion is due to reciprocal chemical action between electrode and electrolyte. This theory is then shown to explain all other connected phenomena; and is further confirmed by showing that the jump for Ag in a Cu salt, *e.g.*, $Cu(NO_3)_2$, is intermediate between that for Ag in $AgNO_3$ aq. and Cu in $Cu(NO_3)_2$ aq.
C. A. S.

842. Periodic Reaction in the H_2–Cl_2 Electrode. K. Biastoch. *Zeits. f. phys. Chem.* 181. *Abt.A.*2. *pp.* 133–150, 1937.—The potential of a Pt electrode immersed in dilute HCl, and surrounded by a mixture of $H_2 + Cl_2$ was determined as a function of the composition of the gas mixture. At low concentrations of Cl_2, variations of potential amounting to over 0·5 V and of about 1 min. duration took place. The variation continued for days, but it can instantly be interrupted when the stable potential of Cl_2 is reached. The conditions for the periodicity were varied over a wide range and the results obtained were reproducible.
F. J. B.

843. Electrometric Behaviour of Palladium Hydride. P. Nylén. *Zeits. f. Elektrochem.* 43. *pp.* 915–921, *Dec.*, 1937.—The behaviour of an electrode covered with Pd black, saturated with H_2, was investigated. The dependence of the potential of the electrode upon the H_2 content was followed. If the H_2 content was equal to or smaller than the concentration corresponding to the hydride Pd_2H, the potential increased to a constant, reproducible value. The potential of the palladium hydride electrode measured against the reversible H_2 electrode, at temperatures of 0·20 and 35° C. gave + 69·0, 59·6, and 52·2. [See following Abstract.]
F. J. B.

***844. New Electrode for pH Measurements. P. Nylén.** *Zeits. f. Elektrochem.* 43. *pp.* 921–923, *Dec.*, 1937.—The use of a Pd electrode for pH measurements is described. The cleaned electrode is covered with Pd black, by electrolysis of a 1 to 2% solution of palladium chloride. The electrode is then saturated with H_2 to form the palladium hydride. The pH value of the solution is given by pH(k) −E/0·0001983, where E is the measured p.d. in volts, and pH (k) is the pH value of the buffer solution. The method has an accuracy of 0·2 mV. [See preceding Abstract.]
F. J. B.

***845. Potential of the Normal and the Decinormal Calomel Electrodes. H. T. S. Britton and G. Welford.** *Chem. Soc., J.* *pp.* 1846–1848, *Oct.*, 1937.—The potentials of the normal and the decinormal calomel electrodes have been determined at a series of temperatures ranging from 12·5° to 91°. These electrodes have been standardised with respect to the arbitrary hydrogen standard at the various temperatures. For the purpose, a specially designed thermostat, in which temperatures were controlled by the vapours of boiling liquids, was used. [See following Abstract.]
AUTHORS.

846. Standardisation of Buffer Solutions at Elevated Temperatures. H. T. S. Britton and G. Welford. *Chem. Soc., J. pp.* 1848–1852, *Oct.*, 1937.—This paper records measurements of the pH values at 12·5°, 25°, 34°, 53°, 6°, 75° and 91° for the Britton-Robinson universal buffer mixture and also for buffer solutions obtained by the separate neutralisation of the constituent acids, *viz.*, citric, diethylbarbituric, and boric acid and KH_2PO_4. The dissociation constants of the acids have been calculated at the different temperatures, and the results discussed. [See preceding Abstract.] AUTHORS.

847. Glass Electrode Measurement of pH of Slightly Buffered and Unbuffered Solutions. E. G. Edwards and D. P. Evans. *Chem. Soc., J. pp.* 1938–1942, *Dec.*, 1937.—The alkaline drift observed by previous investigators when using the glass electrode in unbuffered solutions has been avoided by agitating the liquid in contact with the membrane, whereby the very small amount of alkali dissolved from the glass is quickly dispersed throughout the test liquid and causes no measurable change in pH. The soft-glass electrodes usually employed for electrometric purposes yield accurate results for the pH of acid solutions, conductivity water of pH about 7·0, very pure water, and solutions of neutral salts. The pH values thus determined agree very well with those given by the isohydric indicator method. Since, in solutions of pH less than 7·0, the glass electrode acquires its equilibrium potential within 1 min., the apparatus is suitable for the measurement of the pH of slightly buffered acidic solutions in which the H-ion concentration is slowly changing. AUTHORS.

848. Temperature Compensation in pH and Conductivity Measurements. F. Lieneweg. *Zeits. f. techn. Physik,* 18. 11. *pp.* 382–387, 1937.—The measurement of salt content of solutions by conductivity, and pH determinations by measurement of the potential of cells, necessitate the exclusion of temperature changes in the apparatus. A suitable circuit for each of the above purposes is described, and the correction for the temperature changes is discussed. F. J. B.

849. Theory of Hydrogen Overvoltage. A. Frumkin. *Acta Physicochimica,* 7. 4. *pp.* 475–484, 1937. *In German.*—The theories put forward to explain H_2 overvoltage are discussed and criticised. F. J. B.

850. Hydrogen Overvoltage and ζ-Potential. Part II. S. Lewina and W. Sarinsky. *Acta Physicochimica,* 7. 4. *pp.* 485–494, 1937. *In German.*—The action of lanthanum chloride upon H_2 overvoltage on a Hg electrode was investigated in solutions containing 0·001, 0·01 and 0·1*N* HCl. The presence of the lanthanum kations resulted in an increase of the H_2 over voltage, which was considered to be connected with the reduction of the diffuse portion of the double layer. The values obtained for the ζ-potential were in opposition to those demanded by the theory of Stern. [For Part I see Abstract 3242 (1937).] F. J. B.

851. Action of Points in Electrolytic Valve Anodes. A. Güntherschulze and H. Betz. *Zeits. f. Physik,* 107. 9–10. *pp.* 633–641, 1937. —With roughened Ta the formation in NaOH solutions first sets in when the current density is 1000 times as great as with highly polished Ta, and falls off exceedingly slowly. The phenomenon is explained by point action. Researches with other electrolytes show that both the onset current density as well as the velocity of formation is a measure of the stability of the combination of the electrons in the anions of the electrolyte. Various consequences deduced from this hypothesis are confirmed by experiment. J. J. S.

852. Passivity of Chromium. E. Müller. *Zeits. f. phys. Chem.* 181. *Abt.A.* 2. *pp.* 89–112, 1937.—Earlier work is discussed [see Abstract 884 (1937)] and continued. The behaviour of electrolytic Cr, and Cr prepared by the thermite reaction, are compared in $2N$ HCl and N H_2SO_4 at room-temperature. The results of the investigation do not support the theory of the oxide surface layer as the cause of passivity. F. J. B.

853. Electrostatic Activity Coefficients in Solvents of Medium Dielectric Constant. P. Gross, P. Kuzmany and M. Wald. *Am. Chem. Soc., J.* 59. *pp.* 2692–2694, *Dec.*, 1937.—The influence of additions of $AgNO_3$, $NaNO_3$ and sodium benzene sulphonate on the solubility of Ag BrO_3 in mixtures of water and isopropyl alcohol of the dielectric constant 25·6, and of additions of LiCl on the solubility of $KBrO_3$ in ethyl alcohol of the dielectric constant $25\cdot7_8$ has been investigated within a range of concentration between 10^{-3} and 10^{-4} mol/l. The results show approximately linear dependence of the logarithm of the activity coefficient on the square root of the ionic strength $\log f = 3\cdot7_6\sqrt{\mu}$. They can be explained by the approximation of Gronwall, La Mer and Sandved, taking ion radii of the size of 2·5 to 2·8 Å. The experiments make it obvious that in the considered range of concentration neither the individual properties of the ions (radius) nor the specific properties of the solvent, except its dielectric constant, are of appreciable significance to the activity coefficient. AUTHORS.

See also Abstract 497 and

349B. Current Density at Kathode and Structure of Electrolytic Metal Deposits. A. T. Wahramian.

350B. Electrolytic Polishing of Aluminium. P. Jacquet.

351B. Electrochemical Study of Deformation of Metals. L. V. Nikitin.

ELECTRONS, NEUTRONS, POSITRONS AND PROTONS.

854. Stern-Gerlach Experiment with Electrons. F. Adler. *Helv. Phys. Acta*, 10. 6. *pp.* 455–470, 1937. *In German.*—A theoretical discussion of the Stern-Gerlach experiment for electrons is carried out on a wave mechanical basis. By a calculation of perturbations, an approximate solution of the wave equation is obtained, which permits of determinations of the polarisation of the electrons at least in a certain region of space. Broadly speaking, the effect of the inhomogeneity of the magnetic field is that electrons with oppositely orientated spins are accelerated in opposite directions. From this theory, in certain cases, the polarisation arises. Unfortunately it is easily shown that the region where the series development converges rapidly is too small to allow of an experimental test of the theoretical predictions. The calculations only apply to electrons whose velocity is non-relativistic. G. O. B.

855. Passage of Very Fast Protons through Matter. M. Drăganu. *Comptes Rendus*, 205. *pp.* 897–899, *Nov.* 15, 1937.—Using the relativistic form of the Fermi β-ray interaction, as given by v. Weizsäcker [see Abstract 5136 (1936)], the effective nuclear cross-section for the production of a positron by a fast proton is calculated on the assumption that the neutrino has zero mass. F. C. C.

856. Passage of Slow Electrons through Metal Foils. H. Katz. *Zeits. f. techn. Physik*, 18. 12. *pp.* 555–558, 1937. *Phys. Zeits.* 38. *pp.* 981–984, *Dec.* 1, 1937.—Examination is made of the passage of slow electrons through Ag foils. At the smallest energies, transmission occurs without loss of energy or change of direction. The transmission curve shows a pronounced maximum as the energy is increased ; when it is increased still further, less than 1% are transmitted with their full energy. The previous treatment of the foil markedly affects the phenomenon. F. C. C.

857. Scattering of Kathode Rays by Metal Foils. E. Kruppke. *Ann. d. Physik*, 30. 7. *pp.* 577–592, *Dec.*, 1937.—Measurements have been made of the angular distribution of kathode rays of velocity 40–70 kV, scattered from Al and Ni foils of thicknesses ranging from 3 to 600×10^{-6} cm. The experimental results are compared with theoretical predictions for single and multiple scattering. The curves given show that in the case of thin foils and the higher velocities there is good agreement between the observations and the theoretical distributions on the basis of single scattering. As the foil thickness is increased and the electron velocity decreased, deviations from this theory occur and the distributions approach closely to those predicted for multiple scattering. The results confirm a modified form of the Wenzel criterion for single scattering. J. E. R.

858. Properties of an Electron Beam of Homogeneous Velocity after Transmission through a Thin Foil. F. Kirchner. *Ann. d. Physik*, 30. 8. *pp.* 683–687, *Dec.*, 1937.—The results of Trillat and Hautot on foils 1μ thick are discussed. In the author's experiments foils up to 10μ thick are examined and the results are not in agreement with those of the former workers. The radius of the diffraction rings increases with an increasing thickness of foil ; this points to a diminution in velocity of the transmitted electrons. The loss is about $0{\cdot}8\%$ for a foil $1{\cdot}1\mu$ thick and $3{\cdot}5\%$ for a foil $3{\cdot}2\mu$ thick. It is not suggested that the results of Trillat and Hautot are in error and an explanation of the difference in the measurements is offered. H. J. H. S.

859. Liberation of Secondary Electrons from Adsorbed Layers. O. Krenzien. *Zeits. f. techn. Physik*, 18. 12. *p.* 568, 1937. *Phys. Zeits.* 38. *p.* 994, *Dec.* 1, 1937.—Preliminary notice of experiments on (1) the liberation of secondary electrons from layers of single atoms of Th and Cs ; (2) emission of electrons from oxide sheets and many-atom oxygen layers. F. C. C.

860. Secondary Electron Emission. Part I. Metals. H. Bruining and J. H. de Boer. *Physica*, 5. *pp.* 17–30, *Jan.*, 1938. *In English.*—In general metals are able to emit a small number of secondary electrons. The electropositive elements have a smaller secondary emission with a primary electron energy of 100 V or more than metals with a high work function. The opposite contention is often encountered in literature ; it is pointed out that this is due to experimental errors (insufficient vacuum) consisting in the fact that the measurements are carried out on the compounds which have a much higher secondary electron emission. Several short statements of the facts observed are given, and these facts will be interpreted in further articles. AUTHORS.

861. Collision of Proton and Deuteron. K. Ochiai. *Phys. Rev.* 52. *pp.* 1221–1225, *Dec.* 15, 1937.—The present calculation is similar to that of Schiff on neutron-deuteron collisions, and is based on the suggestion of Morse that the function $\sin (kr + \delta) - e^{-ar} \sin \delta \cos kr$ will be a good approximation to the actual wave function if the parameters are properly adjusted. By joining this function smoothly with the Coulombian field wave function, the scattering formula is obtained for proton-deuteron collisions, while, by extending this function to infinity, the neutron-deuteron scattering is found. The coordinate system, in which the Hamiltonian is separable, was used, and this is the main difference from Schiff's calculation The cross-section for neutron-deuteron scattering was found to be $3 \cdot 2 \times 10^{-24}$ cm^2. at vanishing neutron energy, in good agreement was obtained. For proton-deuteron scattering, no good agreement was obtained. In the range of angle of scattering less than about 70°, the calculation gives still a tolerable result, but, for larger angles, the experimental scattering increases very rapidly. Such a rapid increase does not seem to be explained without some other important improvement of the theory. AUTHOR.

862. Neutron Resonance Levels for Ir and Rh and Comparison of Yields. R. Jaeckel. *Zeits. f. Physik*, 107. 9–10. *pp.* 669–679, 1937.—The resonance absorption of neutrons by Rh and by Ir is examined with reference to the dependence of the absorption coefficient on the energy. Substitution of the results in the formula already deduced by the author [see Abstract 2306 (1937)] gives values for K_0 of 25 cm^2./gm. and 17 cm^2./gm. for Rh and Ir respectively. The difference between the Ir and Rh resonance levels is not greater than 0·1–0·2 eV, which is about the breadth of the resonance lines themselves. The Doppler breadth is less than the line breadth in both cases. F. C. C.

863. Angular Scattering of Neutrons by Protons. E. Philipp. *Zeits. f. Physik*, 107. 9–10. *pp.* 683–708, 1937.—On the basis of recent experiments which have yielded variations in the spherically symmetrical distributon of neutrons in a central system, and on the general theory of elastic scattering including the hypothesis of elementary potential holes, the author has investigated theoretically the value of the reciprocal action potential between neutrons and protons. In conjunction with deuteron theory, there follows from this the necessity of interchange forces; the necessary equations for these have been set up, which however are not sufficient for a determination of the potential on the basis of the experiments existing at present. G. O. B.

864. Absorption of Group C Neutrons in Ag, Cd and B at Different Temperatures. F. G. Houtermans, A. I. Leipunsky and L. Rusinov. *Phys. Zeits. d. Sowjetunion*, 12. 4. *pp.* 491–492, 1937. *In English.*—Absorption curves for group C neutrons in Ag, Cd and B were obtained at different temperatures in the centre of a Dewar flask using the 200 sec. Ag activity as detector. The measurements agree well with the $1/v$ law for absorption of slow neutrons in B and Ag. For Cd the law does not hold, pronounced resonance effects occurring at certain velocities. At temperatures higher than room-temperature the behaviour of the neutrons agree with a Maxwellian distribution of velocities; the behaviour of low temperatures is explained on the basis of departure from the Maxwellian distribution law. F. C. C.

865. Neutron Absorption Limit in Cadmium. J. G. Hoffman and M. S. Livingston. *Phys. Rev.* 52. *pp.* 1228–1231, *Dec.* 15, 1937.—In order to find the high energy absorption limit in Cd the absorption in B of the transmitted neutrons was measured. The slow neutron absorption coefficient in B is found to be 38 cm^2./gm. in agreement with Amaldi and Fermi. The Cd penetrating neutrons are inhomogeneous in energy and therefore are not absorbed exponentially but according to the law $(1 - e^{-x})/x$, where $x = \kappa\delta$, κ is the absorption coefficient for neutrons just penetrating Cd and δ is the thickness of B traversed. κ is found to be 9·5 cm^2./gm. B. A sheet of Cd 0·5 mm. thick reduces the neutron counts to 8·4% of the total; 5·7% are absorbable in heavy layers of B. Assuming the $1/v$ law for the absorption of neutrons in B the absorption limit in Cd is found to be 0·41 eV. With the aid of data from the wheel experiment of Rasetti and collaborators the resonance energy and the half-width are calculated and are $E_r = 0{\cdot}18$ eV and $\Gamma = 0{\cdot}15$ eV respectively. An estimate is made of the neutron width which turns out to be $\Gamma_n = 1{\cdot}3 \times 10^{-3}$ eV. AUTHORS.

866. Multiple Scattering of Neutrons. Part I. Theory of the Albedo of a Plane Boundary. O. Halpern, R. Lueneburg and O. Clark. *Phys. Rev.* 53. *pp.* 173–183, *Jan.* 15, 1938.—The paper contains the rigorous solution of the following problem in multiple scattering: a beam of particles impinges with arbitrary velocity distribution upon the plane boundary surface of a body which extends towards infinity on the other side of the boundary. In this body the particles have a finite probability of being either captured or scattered without loss of energy. The probability of scattering shall be spherically symmetrical in the laboratory frame of reference. Number and velocity distribution of the returning particles are given explicitly; density as well as velocity distribution of the particles inside the body are determined by the formulæ but not worked out in detail since they lack direct physical interest. The result is found to depend on the ratio of the capture to the scattering cross section and on the velocity distribution of the incident particles. Applying the theory to the diffuse reflection of slow neutrons at paraffin surfaces it is found that agreement with observations and previous determinations of the capture cross-section can exclusively be obtained, if the active level of the "deuterons with spin zero" is virtual. The connection of these results with some other experiments on the velocity and magnetic moment of the neutrons is discussed. AUTHORS.

867. Focusing of Charged Particles by a Transverse Magnetic Field. L. Cartan. *J. de Physique et le Radium*, 8. *pp.* 453–470, *Nov.*, 1937.—The conditions which are necessary for the focusing of a beam of charged particles are considered from a purely geometrical standpoint. The construction of the image of an object is given for the general case and also for certain simple cases which arise in practice. The point at which a ray impinges on a photographic plate is calculated for the general case on the assumption that the limits of the magnetic field are linear. A number of important conclusions may be derived from this theoretical work; amongst them are the position of the plate to give maximum definition and the conditions for maximum dispersion and for a linear spectrum. In illustration of the practical application, several experimental arrangements are suggested which possess advantages over those usually employed.

H. J. H. S.

868. Electron Mirrors. G. Hottenroth. *Ann. d. Physik*, 30. 8. *pp.* 689–712, *Dec.*, 1937.—Potential fields of different types are described and their potentialities as electron mirrors are discussed. A description is given of an electron mirror arrangement by means of which various dispositions of electrode form and potential distribution may be investigated. It is found that an *einzellinse* system gives rise to a considerable amount of spherical aberration if the mirror is arranged to be converging. The aberration largely decreases if the electrode potentials are altered to give a diverging system. Converging mirrors may be constructed and a number of examples are given of 3-electrode systems and of the results given by them. The application of an electron mirror to the study of surfaces by reflection is illustrated. H. J. H. S.

***869. Application of the Electron Microscope in Biology. F. Krause.** *Naturwiss.* 25. *pp.* 817–825, *Dec.* 17, 1937.—A detailed description is given of the construction and use of the electron microscope for the investigation of objects of ultra-microscopic dimensions. The basis of electron optics is discussed and the advantages of this type of apparatus are indicated. A number of difficulties in the use of the electron microscope in biological investigations are pointed out, and it is suggested that as these difficulties are now being overcome the use of the instrument for this type of work is now practicable. Examples of electron microscope photographs with magnifications up to 3000 are given. J. E. R.

***870. Electron Microscope in Colloid Investigations. D. Beischer and F. Krause.** *Naturwiss.* 25. *pp.* 825–829, *Dec.* 17, 1937.—A number of examples are given of the use of the electron microscope in the investigation of colloidal particles. By using a combination of the electron microscope and a low power optical instrument, magnifications up to 30,000 are obtained. In this way it is possible to determine the size and the geometrical form of the particles. J. E. R.

***871. Electron Microscope for Studying Thermal and Secondary Electron Emission. E. Meschter.** *Rev. Sci. Instruments*, 9. *pp.* 12–15, *Jan.*, 1938.—The construction of a magnetic electron microscope for the observation of self-emitted and secondary electrons from the same surface is described. Primary and secondary images obtained are illustrated. AUTHOR.

***872. Statistical Measurement of Electron Rays. K. H. Stehberger.** *Ann. d. Physik*, 30. 7. *pp.* 621–634, *Dec.*, 1937.—The properties of *wendelstrahlen*, that is, of slow electron rays curling in a magnetic field, are examined theoretically and experimentally. Investigation is made of the disturbance caused by the introduction of a cylindrical probe. In combination with a transverse electric field, the properties of the rays are used to devise a new form of electrometer. F. C. C.

See also Abstracts 388, 417, 472, 600, 608, 617, 618, 627, 628, 630, 817.

ELECTROSTATICS.

873. Electrostatic Problems Connected with Thick Cylindrical Shells. E. P. Adams. *Am. Phil. Soc., Proc.* 78. 2. *pp.* 245–270, 1937.—The problem of determining the distribution of electricity on an infinitely long cylindrical shell, the cross-section of which is an arc of a circle, was solved by Bickley in 1926. In the present paper the solution is given for a shell of finite thickness, that is, an infinitely long cylinder the cross-section of which is bounded by two concentric circular arcs and two radii. The distribution of electricity on the shell is determined when it is freely charged, and the distribution of the induced charge is found when the shell is placed in a uniform electric field. The solution of the problem for a single thick shell is then modified so as to apply to two equal, symmetrically placed thick shells. This is one of the very few problems for which an exact solution has been obtained by means of which the effect of finite thickness of the plates of a cylindrical condenser can be evaluated. A table is given to show the amount of this effect in a number of condensers of different dimensions. AUTHOR.

874. Two-Dimensional "Ice-Pail." E. P. Adams. *Phil. Mag.* 24. *pp.* 1127–1132, *Dec.*, 1937.—In the treatment of the electrification of a freely charged two-dimensional ice-pail by transforming the z-plane of the conductor into the interior of a circle in a w-plane by Schwarz's method, it is difficult to get numerical results, using the method of mechanical quadrature, when the ratio of the lengths of the sides to the base exceeds about 0·6. If half the z-plane be transformed to the upper half of the t-plane by the Schwarz-Christoffel method the problem can be solved with the aid of elliptic functions, and numerical results are obtained for any values of the ratio. N. M. B.

875. Explanation of the Coehn-Raydt Law of Charge. A. J. Rutgers. *Physica,* 5. *pp.* 54–59, *Jan.*, 1938. *In German.*—Coehn and Raydt investigated the electro-endosmose of organic liquids in glass capillaries; the so-called Coehn-Raydt law of charge is based on these investigations [see Abstract 145 (1910)]. The law is here reduced to the form $\zeta = aD_w\,(1/\mathrm{D}_w - 1/\mathrm{D}_z)$, in which a is a constant, D_w and D_z the dielectric constants of the wall of the tube and of the liquid respectively, and ζ the electrokinetic potential. The total transverse discontinuity of potential, ϵ, at a wall composed of ions is conceived as arising owing to a difference of solubility of positive and negative ions. It is shown that this conception gives a value of ϵ which is of the correct order of magnitude in the case of a wall formed of silver iodide. J. S. G. T.

GALVANOMAGNETIC AND THERMOMAGNETIC EFFECTS.

876. Theory of Semiconductors in Magnetic Fields. M. Sen Gupta. *Indian Journ. Phys.* 11. *pp.* 319–332, *Dec.*, 1937.—The present paper investigates the theory of change of resistance of semiconductors in magnetic fields. In the first part of the paper a brief statement of Wilson's model of impurity semiconductor is given. In the second and third parts general mathematical formulation of conductivity is derived, taking into consideration Lorentz force only, for the models of Bloch and Nordheim. In the fourth part a general discussion of the foregoing results together with a critical résumé of Harding's paper on change of resistance of semiconductors [see Abstract 3221 (1933)] is given. The difficulties of accepting Harding's paper *ipso facto* are indicated. AUTHOR.

See also Abstracts 836, 899.

MAGNETISM AND ELECTROMAGNETISM.

877. Reciprocals to Ampère's Law. P. B. Carwile. *Phil. Mag.* 25. *pp.* 175–183, *Jan.*, 1938.—An application of the well-known principle of reciprocity between corresponding electric and magnetic entities leads to an explicit statement of the reciprocal to a common form of Ampère's law. The same principle leads to the law of equivalent electric shells. These laws are believed to reduce certain aspects of magneto-electric fields to a more elementary level than has been common. Applications are made to several simple theorems. The laws are briefly discussed as to formal and physical significance. AUTHOR.

878. Properties of Ferromagnetic Substances in Powder Form. O. Sappa. *Ricerca Scientifica,* 2. *pp.* 413–421, *Oct.*, 1937.—The coercive force in a powder depends on grain size. For magnetite it is over 260 gauss with a grain size of the order of 1 μ as against 4 gauss for the bulk substance For still smaller grains it tends to an asymptotic value. The origin of the phenomenon may either be magnetostriction, or the existence of a surface layer with anomalous properties. R. P.

879. Heisenberg's Theory of Ferromagnetism. T. Yamanouchi. *Phys. Math. Soc., Japan, Proc.* 19. *pp.* 1003–1018, *Nov.*, 1937. *In English.*—A simple method for finding the asymptotic values of the group characters of the symmetric group is described. It is applied to obtain the magnetisation of a ferromagnetic crystal, when each atom is found in an arbitrary multiplet state, giving rigorous proof of Heisenberg's theory. AUTHOR.

880. Anisotropy of Cubic Ferromagnetic Crystals. J. H. van Vleck. *Phys. Rev.* 52. *pp.* 1178–1198, *Dec.* 1, 1937.—It is suggested that the interplay between orbital valency and spin-orbit interaction may account for the relation between the intensity of magnetisation and the orientation in cubic single crystals. Owing to the spin-orbit coupling, the spin vectors responsible for the ferromagnetism are affected by the anisotropic electrostatic forces which connect the orbital angular momenta of different atoms. This leads to the apparent dipole-dipole coupling between the spin of different atoms, the proportionality constant being greater than that due to pure magnetic forces between spins. In certain cases quadrupole-quadrupole coupling may occur. Dipole-dipole coupling is only appreciable in the 2nd approximation of perturbation theory in which complete parallelism of the elementary magnets is not assumed. Perturbation calculations may be performed for dipole or quadrupole models on the basis of a Weiss molecular field, in which case a constant may be deduced which agrees with that observed experimentally. The relation between the model suggested and other models of ferromagnetic anisotropy in the literature is discussed. An explanation is offered of the discrepancy in magnitude and sign of the lattice sums in magnetostriction when calculated on the basis of pure magnetic coupling between the spins. A brief account is given of the anisotropy of hexagonal crystals. H. J. H. S.

881. Diamagnetic Anisotropy of Cyclic Molecules. J. Frenkel and V. Saveliev. *Phys. Zeits. d. Sowjetunion,* 12. 4. *pp.* 435–457, 1937. *In German.*—The theory of the magnetic anisotropy of cyclic molecules is discussed mathematically. Two different mechanisms of electron motion in such molecules are considered, and the temperature dependence of the anisotropy is discussed. A possible extension to metals in the supraconducting state is considered. W. R. A.

882. Dia- and Paramagnetism in Metallic Mixed Crystals. Part V. Effect of Dissolved Cobalt and Rhodium. E. Hildebrand. *Ann. d. Physik,* 30. 7. *pp.* 593–608, *Dec.*, 1937.—The magnetic properties of the alloys Au-Co, Cu-Co and Pt-Rh were investigated as to the effect of weak concentrations of Co and Rh for the temperature range − 190° to + 640° C., the last-named metals having nine outer electrons. Co follows the Weiss law, and the first additions of it to Au and Cu have the same magnetic moment in the same basic metal, namely, Au-Co $\mu_B = 4 \cdot 6$, Cu-Co $\mu_B = 5 \cdot 4$. The θ constants lie between − 160° and − 250° for Au-Co, and between − 860° and − 1020° for Cu-Co. The solubility of Co in Au and Cu at temperatures below 500° C. is much smaller than has been previously stated. With Rh alloys there is a maximum susceptibility at 25% (atomic) Rh which can be explained with the aid of the crystal structure. Within the 25% Rh range, the paramagnetic Pt acts as a neutral basic metal. The Weiss law held only for the alloy with the smallest addition of Rh (9% atomic) for which $\mu_B = 1\cdot9$ and $\theta = -90°$. [For Part IV see Abstract 3750 (1937).] G. E. A.

***883. Paramagnetic Measurements at Low Fields with the Rankine Balance. H. P. Iskenderian.** *Phys. Rev.* 52. *pp.* 1244–1245, *Dec.* 15, 1937.—The Rankine magnetic balance previously reported [see Abstract 3759 (1937)] has been adapted for making paramagnetic measurements at low fields. An analysis of the stability of the balance under these conditions is given. The volume magnetic susceptibilities of gaseous O_2 and of aqueous $NiCl_2$ solutions relative to water are reported, and from these values the relative mass susceptibilities of O_2 and $NiCl_2$ are deduced. The mass susceptibility of H_2O is assumed to be $-0\cdot7200 \times 10^{-6}$, in terms of which, that of O_2 is $104\cdot4 \times 10^{-6}$ and of $NiCl_2$ is $33\cdot97 \times 10^{-6}$. AUTHOR.

884. Paramagnetic Dispersion in Iron Alum. F. Brons and C. J. Gorter. *Physica,* 5. *pp.* 60–64, *Jan.,* 1938. *In English.*—The paramagnetic dispersions of iron alum and of an alum in which 20% of the trivalent ions are iron and the remainder are aluminium, are investigated in parallel magnetic fields up to 4000 oerstedt, at temperatures 64°–90° K and at frequencies $0\cdot202 \times 10^6$ to $3\cdot82 \times 10^6$. At low temperatures, high frequencies and high constant fields the susceptibility of iron alum vanishes nearly completely; about 7% of the normal susceptibility apparently persists. This residue may possibly disappear at lower temperatures. Much higher fields are necessary to inhibit the susceptibility of the diluted iron alum than are necessary to inhibit correspondingly that of the pure iron alum. J. S. G. T.

885. Magnetic Properties of Mercuri-Iodides. F. Gallais. *Comptes Rendus,* 205. *pp.* 1052–1054, *Nov.* 29, 1937.—In order to ascertain whether Hg in these complexes exhibited a feeble paramagnetism or retained its diamagnetism, measurements have been made on K_2HgI_4, Na_2HgI_4 in alcohol and $HgI_2\cdot KI\cdot H_2O$ in acetone by means of a modified Gouy arrangement. Experimental values are in tolerable agreement with calculated values and it is concluded that Hg in these compounds is diamagnetic. W. R. A.

886. Method of Images for Calculating Electric and Magnetic Fields. E. A. Meyerovitz. *Phil. Mag.* 25. *pp.* 66–90, *Jan.,* 1938.—In this paper a method for field calculation is described, giving a rather simple result which may be of great practical importance in many cases. The application of this method is closely associated with the formation of the Riemann surface in accordance with each given problem and the distribution on this surface of a system of images of the sources exciting the field. The method is used for calculating the field of charges in proximity to conducting surfaces and the field of currents in proximity to iron masses. Simultaneously the possibility is also examined of combining the generalised method of images with the method of conformal transformation. In conclusion it is shown that the examination method used is also suitable for some cases of the finite magnetic permeability of iron or the finite dielectric constant of the dielectric. AUTHOR.

***887. Regulator Systems for Electromagnets. H. L. Anderson, J. R. Dunning and D. P. Mitchell.** *Rev. Sci. Instruments,* 8. *pp.* 497–501, *Dec.,* 1937.—A regulator for maintaining constant, to better than 0·1% over long periods, the magnetic field of large (100 kW) electromagnets is described. This consists of two basic components: (1) A valve voltage regulator which compensates for rapid changes in voltage and thus

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anticipates the change in current which would result. (2) A current actuated element arranged so as to alter the operating point of the voltage regulator in order to compensate for slow changes in current due to changes in the temperature of the windings. Very rapid regulator action is secured with no drift or hunting to the limit specified. AUTHORS.

See also Abstracts 421, 588.

MEDICAL RADIOLOGY AND ELECTROLOGY.

***888. Metallic Intensifying Screens. H. E. Seemann.** *Kodak Research Lab., Comm. No.* 639. *J. of Applied Physics,* 8. *pp.* 836–845, *Dec.,* 1937.—Owing to the advance of industrial radiography the use of intensifying screens has become especially advantageous. Elements of high atomic number are the most suitable for such screens, lead being the most commonly employed material. Most of the intensifying action seems to be due to the emission of electrons and little to the characteristic and scattered X-rays. The intensification factor increases with the voltage used in producing the X-rays between voltages of 160 kV and 200 kV, but it appears to decrease with a sufficient decrease of X-ray wave-length. It is desirable to have the back screen fairly thick. The thickness of the front screen is chiefly determined by its effect on the secondary radiation; a satisfactory value is between 0·010 and 0·015 cm. The screens must be kept clean, since light contaminating materials considerably absorb the intensifying radiations. Intimate contact between the screen and plate is necessary. There seems to be little chance for improvements by the addition of a fluorescing surface layer. G. G.

889. Spectral Distribution of Scattered X- and γ-Rays. R. Payne-Scott. *Brit. J. of. Radiology,* 10. *pp.* 850–870, *Dec.,* 1937.—A study of the absorption coefficients shows that the ratio between the amount of scattered energy absorbed in water to the amount of incident radiation similarly absorbed has a maximum value for a wave-length of about 150X. in the incident radiation, but its actual position depends on the atomic number of the scattering medium. Calculations, based on the Klein-Nishina formula for spectral distribution are made for incident wave-lengths of 17·1, 50, 200 and 400 X. with the following results. The above mentioned maximum should be at a wave-length of 200 X. and the ratio should be very small for short wave-lengths. This finding is reconciled with the experimental value by assuming that in practice the scattered radiation includes a considerable amount for second and higher order scattering. An increase beyond 5 cm. in thickness of the medium has little effect on the amount of scattered radiation absorbed. Curves for spectral distribution show that most absorption takes place in the region of the incident wave-length. G. G.

890. Prevention and Treatment of X-Ray Injuries of the Skin. H. Schmitz. *Am. J. of Roentgenology and Radium Therapy,* 38. *pp.* 893–898, *Dec.,* 1937.—The production of skin injury by X-rays is discussed in respect to quality, time and field of irradiation and the effects produced in the skin. In respect to treatment the medical treatment should be expectant and conservative, rather than meddlesome, poultices, etc., being avoided. The general medical treatment, particularly in respect to the relief of pain, is discussed. B. J. L.

891. Effect of Increase in Voltage (150-300 kV Peak), Filtration and Skin-Target Distance on the Percentage Depth Intensity. C. L. Randall. *Am. J. of Roentgenology and Radium Therapy,* 38. *pp.* 903–914, *Dec.,* 1937.—Study of the percentage depth dose at 10 cm. or other single point is not a reliable method of determining the relative importance of the physical factors which determine the effectiveness of radiation at a depth. Relative intensities are studied at various depths of a phantom and comparison is based upon a series of absorption curves. To evaluate the effective combination of the physical factors in deep X-ray therapy, consideration must be given to purely clinical considerations as well as to filtration, higher voltages, and longer skin-target distance, this being shown by means of various graphs and tabular data. B. J. L.

***892. Radiological Applications of the Geiger-Müller Counter. C. B. Braestrup, E. J. Murphy and M. D. Whitaker.** *Am. J. of Roentgenology and Radium Therapy,* 38. *pp.* 915–922, *Dec.,* 1937.—To detect and measure stray radiation injurious to personnel it has commonly been the case to use ionometric electrometer apparatus, which has limited application, insufficient sensitivity, consumes time in operation and does not demonstrate directional effects. The Authors, to overcome these objections, have designed and used a device of the Geiger-Müller counter type, which has also been used by other investigators. A detailed description is given of the apparatus and tubes, designed for portability rather than exact quantitative measurements. The results show high sensitivity and distinct advantages in the measurement of stray radiation from radium or X-ray apparatus and directional results may be obtained much more advantageously than with ionometric instruments. Further investigations are being made to construct apparatus showing less variation in respect to wave-length, although this variation is small, when compared with photographic methods. B. J. L.

893. Measurement of X-Ray Dosage by the Effect on Chromosomes. A. Marshak and J. C. Hudson. *Radiology,* 29. *pp.* 669–675, *Dec.,* 1937.—Reference is made to the difficulty of measuring dosage at high X-ray voltages in the region of 1,000 kV and it is proposed for this purpose to use the production of chromosome abnormalities by radiation, which is quantitatively the same in plant and animal tissues. For this purpose commercial onion seeds are germinated under standard conditions given in detail and the abnormalities produced in the root tips have been studied. Ease of manipulation, low biological variability and consistency of response, are claimed. The method is stated to be independent of wavelength over the range of voltage of 180–400 kV studied, and ion pairs and not the quantum are considered responsible for the effects which have been observed. B. J. L.

***894. Condenser Discharge X-Ray Tube. K. H. Kingdon and H. E. Tanis, Jr.** *Phys. Rev.* 53. *pp.* 128–134, *Jan.* 15, 1938.—A condenser discharge X-ray tube is described from which it is possible to obtain a reproducible X-ray dose of $3 \cdot 5$ r. in about 5×10^{-4} sec. The current through the tube was of the order several hundred amperes. The effects of these high intensity X-ray pulses have been compared with the effects of X-rays of ordinary intensity from a Coolidge tube operated at a current of about 1 mA. The ordinary small chamber dosimeter was found to have a large recombination error for the high intensity pulses. The Bunsen-Roscoe reciprocity law was found to hold for the blackening of photographic plates, and for the coloration of crystals, by the high intensity pulses. Biological effects produced by the high intensity pulses in drosophila eggs, in the spores of aspergillus niger, and in wheat seedlings were found to be approximately the same as those produced by equal doses of X-rays of ordinary intensity. AUTHORS.

895. Relative Biological Effects Produced by Equal Radiation Doses from Radium and from Radon. W. H. Love. *Brit. J. of Radiology*, 11. *pp.* 46–64, *Jan.*, 1938.—It has been possible to make an analysis, based on accepted facts, of the problem concerning the relative biological effects produced by equal γ-ray doses administered from a radium and from a radon source. It has been shown that either agency may be equally, more, or less effective than the other, depending upon the conditions of the irradiation, and the characteristics of the irradiated tissues. A number of particular cases have been considered in detail, and methods of treating the most general cases have been indicated. It has also been shown that, in the case of a slowly growing tissue, in which the duration of the radio-sensitive interval is sufficiently small, the maximum biological efficiency of a given radiation dose from radium is greater than that of the same dose from radon. AUTHOR.

See also Abstracts 745, 802 and

469B. Innocuity of Alternating Voltages below 65V. L. Kervran.

470B. Present Knowledge of the Causes of Death by Electrical Accidents. H. Freiberger.

471B. Effect of Electromagnetic Centimetre Waves on the Central Nervous System. S. J. Turlyguin.

OSCILLATIONS AND WAVES.

896. Theory of Ionosphere. Part I. R. C. Majumdar. *Zeits. f. Physik*, 107. 9–10. *pp.* 599–622, 1937.—In Section I an investigation is made, using quantum mechanics, of the physical properties, such as conductivity, dispersion, absorption, etc., of a medium consisting of free electrons and particles (positive or negative ions, neutral atoms or molecules) which is subjected to the simple periodic electric field of the incident wave and to a constant external magnetic field. In Section 2 the theory is applied to the special problem of the ionosphere and general formulæ are derived for the index of refraction and the polarisation. The accurate evaluation of the expressions for the dispersion, absorption and polarisation is only carried out for an ideal ionosphere consisting of electrons and positive ions. Section 3 deals with the possible compositions and temperatures of the upper atmosphere, as given by a comparison of observation and theory, and the paper concludes with a discussion of the quantisation effect induced by the external magnetic field on the electron motion in the ionosphere. A. W.

See also Abstracts 501, 812 and

589B. Propagation of Ultra-Short Waves. H. Plendl and G. Eckart.

591B. Reflection of Broadcasting Waves in the Atmosphere. C. Mihul and I. Mihul.

592B. Measuring the Reflecting Regions in the Troposphere. A. W. Friend and R. C. Colwell.

593B. Ionosphere Investigation with Limiting Waves. O. Burkard.

594B. Characteristics of the Ionosphere at Washington. T. R. Gilliland, S. S. Kirby, N. Smith, and S. E. Reymer.

622B. Clarification of Average Negative Resistance with Extensions of its Use. C. Brunetti.

PHOTOELECTRICITY.

897. Negative Photoconductivity in Polycrystalline Cuprous Oxide. P. G. Borziak. *Phys. Zeits. d. Sowjetunion,* 12. 4. *pp.* 481–484, 1937. *In English.*—The decrease of conductivity of Cu_2O cells under the action of white and green light is investigated at the temperature of liquid air when the Cu electrode is negative. AUTHOR.

See also Abstracts 621 and

541B. Light-Sensitive Cell Reflectometer. G. R. Baumgartner.

542B. Problem Concerning Photoelectric Photometry. S. Barletta.

PIEZOELECTRICITY.

See Abstracts 474, 747, 797, 800 and

380B. Luminous Quartz Resonators. F. Galotti.

630B. Electrical Equivalent Constants of Piezoelectric Crystals. R. Günther.

THERMIONICS.

898. Positive Ion Emission from Heated Nickel Wire in Oxygen and Hydrogen. R. Goto. *Imp. Acad. Tokyo, Proc.* 13. *pp.* 320–324, *Oct.,* 1937.—*In English.*—A Ni filament is heated to between 700 and 950° C. and kept at a positive potential to a Ni plate. When the filament is first heated in H_2 a large current is seen, which drops rapidly to zero. If the filament is now treated in either H_2 or O_2, no current is seen, but if the preliminary heating is in O_2, there is a current which gradually decreases, as also does the pressure of the gas, both in O_2 and H_2. A saturation curve between voltage and current is shown. The conclusion is that the preliminary heating in O_2 causes the Ni wire to become oxidised or to absorb O_2 and further heating in either gas causes positive ions to be emitted. H. M. B.

See also Abstract 871 and

390B. Thermionic Trigger. O. H. Schmitt.

THERMOELECTRICITY.

899. Influence of a Longitudinal Magnetic Field on the Thermoelectric Power of Ni and of Ferro-Nickels Submitted to Traction. G. Simon and J. Bouchard. *Comptes Rendus,* 205. *pp.* 1141–1143, *Dec.* 6, 1937.—Experiments were carried out on wires of Ni and various ferro-nickels. Determination was made of the variation of the e.m.f. for temperatures between 0° and 450° of couples formed of Cu and each of the ferromagnetic metals examined, when the couples were under (1) a constant longitudinal magnetic field between 0 and 800 gauss, (2) a constant mechanical tension between 0 and 15 kg./mm². The difference of temperature at the junctions, t_1-t_0, was maintained by a small electric furnace and by a thermostat with circulating water. The behaviour of different specimens varies with the percentage of Ni they contain. Increase of tension has an effect which varies with the amount of Ni and with the strength of the magnetic field. J. J. S.

See also Abstracts 560 and 836.